1965

An investigation of aircraft accidents aboard deployed CVA's during 1962 and 1963

Powell, Wendell W.

Monterey, California : Naval Postgraduate School

http://hdl.handle.net/10945/12400

UNCLASSIFIED [redacted] UNCLASSIFIED

[redacted]

UNITED STATES
NAVAL POSTGRADUATE SCHOOL

THESIS

P7687

AN INVESTIGATION OF AIRCRAFT

ACCIDENTS ABOARD DEPLOYED CVA'S

DURING 1962 AND 1963

* * * * *

Wendell W. Powell

GROUP-4
DOWNGRADED AT 3-YEAR INTERVALS
DECLASSIFIED AFTER 12 YEARS
DOD DIR 5200.10

[redacted]

UNCLASSIFIED

UNCLASSIFIED

[redacted]

AN INVESTIGATION OF AIRCRAFT

ACCIDENTS ABOARD DEPLOYED CVA'S

DURING 1962 AND 1963

* * * * *

Wendell W. Powell

[redacted]

UNCLASSIFIED

[redacted]

AN INVESTIGATION OF AIRCRAFT ACCIDENTS ABOARD DEPLOYED CVA'S DURING 1962 AND 1963

by

Wendell W. Powell

Lieutenant, United States Navy

Submitted in partial fulfillment of
the requirements for the degree of

MASTER OF SCIENCE
IN
OPERATIONS RESEARCH

United States Naval Postgraduate School
Monterey, California

1 9 6 5

[redacted]

UNCLASSIFIED

[redacted]

AN INVESTIGATION OF AIRCRAFT ACCIDENTS ABOARD DEPLOYED CVA'S DURING 1962 AND 1963

by

Wendell W. Powell

This work is accepted as fulfilling

the thesis requirements for the degree of

MASTER OF SCIENCE

IN

OPERATIONS RESEARCH

from the

United States Naval Postgraduate School

UNCLASSIFIED

[redacted]

ABSTRACT

Many proposed solutions for preventing aircraft accidents in the U. S. NAVY have led to elimination of some of the obvious causal factors. Underlying factors related to Attack Carrier operating methods and pilot performance are examined for aircraft accidents which occurred during deployments from 1962 through 1963. Variables derived from CVA operating schedules for the SIXTH and SEVENTH FLEETS are illustrated and compared. Conditions surrounding aircraft accidents, such as length of time on deployment, time at sea and in port, and pilot's experience are studied to determine similarities and differences in fleet operations. Computer programs are presented which were written to process and display the data contained in ship movement reports and aircraft accident reports.

[redacted]

UNCLASSIFIED

UNCLASSIFIED

TABLE OF CONTENTS

UNCLASSIFIED

LIST OF ILLUSTRATIONS

LIST OF ILLUSTRATIONS (cont.)

1. Introduction and Summary.

The study of aircraft accidents that occur as a result of attack carrier operations was suggested by the U. S. Naval Aviation Safety Center. The study is to be part of a proposed fleetwide study of accidents incident to all types of carrier operations, with intent to analyze the occurrence of accidents as related to differences in methods of operations.

Attack carrier operations and their associated aircraft accidents during calendar years 1962 and 1963 form the basis for a comparison of the SIXTH and SEVENTH FLEETS. Variables were defined and calculated which pertained to individual, ship, and fleet operational accidents with the intent to distinguish where possible between the fleets.

In general, the SIXTH and SEVENTH FLEETS operated in a similar manner. The length of periods at sea for the two fleets was found to come from the same distribution. However, they were shown to differ in the length of periods spent in port. Accidents occurred in both fleets at approximately a constant time rate, with the SEVENTH FLEET having a slightly higher rate since it had 1.6 more carriers deployed on the average than the SIXTH FLEET. No significant difference was found in the number of accidents per carrier operating days for the two fleets. The distribution of accidents during a deployment for the CVA's of each fleet was found to be the same, as was the distribution of time at sea prior to an accident. Each of the CVA's was found to operate in a manner consistent with its parent fleet. The percent of accidents encountered on deployment did not differ significantly within or between the two fleets.

In this study the operational performance of the two fleets was found to be essentially the same, as was their safety performance. It is therefore concluded that variables other than those analyzed in this study must be found to distinguish between the two fleets.

2. Data and Assumptions

Data pertaining to each aircraft accident was supplied by the U. S. Naval Aviation Safety Center in the form of an IBM punch card deck consisting of three data cards per accident. The cards contain information coded in alphanumeric form which was transferred from the original Aircraft Accident Reports. The first two cards in each sequence contain general and supplementary information, a description of the accident and primary and secondary cause factors. The third card contains personnel statistics pertaining to the pilot and crew involved in the accident. Computer programs for processing and displaying this data are listed in Appendix II.

Ship operating and employment schedules were obtained from COMNAVAIRLANT and COMNAVAIRPAC. In addition, microfilm containing individual ship movement reports were supplied by NASC. A method was developed for coding the operating status of a ship in such a way as to determine whether the ship was deployed, at sea or in port for each day in a desired time span. This served as input for a computer program to calculate variables related to the carrier's operating plan. This program is listed in Appendix II.

Detailed operational data such as flight hours, carrier landings, etc., was available on OPNAV ZULU tapes for each aviation unit involved. However, the format and content was such that this information could not be utilized in the time allotted for this study. For further explanation, see Appendix I.

In general, each of the variables to be analyzed in this study is examined in three categories, (a) combined fleets, which includes all CVA's regardless of deployed status, (b) SIXTH FLEET, which is limited to those CVA's actually deployed or enroute to or from the Mediterranean area, and (c) SEVENTH FLEET, which also is limited to those CVA's deployed or enroute to or from the SEVENTH FLEET deployment area.

The FIRST and SECOND FLEETS are not categorized for several reasons. Primarily, sufficient data was not available for accurately determining periods at sea and in port since much of this operation is on a local area basis, and the carriers do not submit movements reports. Also, much of the time is spent in training new personnel, on RAG qualifications and individual ship proficiency training. These conditions are not typical of a ready carrier on deployment.

A deployment is assumed to begin when a carrier departs CONUS enroute to a forward area, and is terminated when the carrier returns to CONUS. Although not technically assigned to their deployed fleet while enroute, many CVA's conducted operations which were under conditions similar to deployment, and analysis of the accidents occurring during these enroute operations should be included for completeness.

Variables related to in port/at sea schedules for the SIXTH and SEVENTH FLEETS were derived primarily from ship movement reports. Any deviation from a ship's schedule as recorded by these reports is not considered in this study. Whenever a CVA was reported to be at sea, the assumption is made that flight operations were being conducted, since the available data does not permit a breakdown of the type of at-sea operations. When a ship leaves or enters a port such that more than half the day is available for operations, that day is counted as a day at sea, otherwise it is a day in port.

Accidents involving more than one aircraft are counted as multiple accidents only if the other aircraft were incident to flight. For example, an inflight collision involving two aircraft is counted as two accidents, whereas a landing accident which destroys other parked aircraft is counted as one accident. This assumption is justified since the aim of this study is to examine all aspects of accident occurrence and analyze all the data pertinent

to any accident. In the case of multiple accidents, data related to all of the involved aircraft, pilots, ships and fleets must be considered. Under this assumption, the number of accidents per CVA will differ from the published values.[1]

[1]NASC. U. S. Navy Aircraft Accident Statistics for the Calendar Year 1963: 47-48

3. Composition of the Fleets.

During calendar years 1962 and 1963 there were fifteen Attack Carriers in operation. Two additional carriers were operating as CVA's at the beginning of 1962 and were reclassified as CVS's during this period. The fleets were composed as follows:

FIRST AND SEVENTH	
TICONDEROGA	CVA 14
LEXINGTON[2]	CVA 16
HANCOCK	CVA 19
B. H. RICHARD	CVA 31
ORISKANY	CVA 34
MIDWAY	CVA 41
CORAL SEA	CVA 43
RANGER	CVA 61
KITTY HAWK	CVA 63
CONSTELLATION[3]	CVA 64

[2] LEXINGTON departed FIRST FLEET in August 1962 for reclassification as CVS.

[3] CONSTELLATION departed Mayport in July 1962 for transfer to the PACIFIC FLEET.

SECOND and SIXTH

INTREPID[4]	CVA 11
SHANGRI LA	CVA 38
ROOSEVELT	CVA 42
FORRESTAL	CVA 59
SARATOGA	CVA 60
INDEPENDENCE	CVA 62
ENTERPRISE	CVA 65

The combined fleets will include all CVA's regardless of deployed status. The SIXTH FLEET and SEVENTH FLEET will include only those CVA's actually deployed or enroute to the deployed area as previously stated.

---

[4] INTREPID was reclassified as CVS 11 on 31 March 1962

4. Accident Occurrence with Time.

Cumulative aircraft accidents were plotted as they occurred in time, using a two year time span beginning 1 January 1962. Fig. 1a is the plot for the combined fleets which shows that the occurrence of the 300 accidents without regard to deployed status is linear. Fig. 1b, showing 70 SIXTH FLEET accidents, and Fig. 1c, showing 103 SEVENTH FLEET accidents, also indicate a linear rate of accident occurrence.

The hazard function h(t) of an underlying probability density function f(t) describes the rate at which a device will fail provided it has not failed prior to a time t. The simplest form of the hazard function occurs when the failure rate is constant. It is shown in [2] that

$$h(t) = \frac{f(t)}{1-F(t)}$$

and

$$f(t) = h(t) \exp \left[- \int_0^t h(t)\, dt \right]$$

Since the rate of aircraft accident occurrence is approximately constant for each of the categories, the hazard function is simply the slope of the line in Figs. 1a, 1b, and 1c. Denoting this slope by λ, the underlying density function becomes

$$f(t) = \lambda \exp(-\lambda t)$$

which is the well known exponential probability density function. The constant λ is interpreted as the rate of accident occurrence and its reciprocal is the mean time to occurrence.

An estimate of the true accident occurrence rate can be made from the available data as plotted. It is known that the limiting distribution of any reasonably behaving function of a sample mean is asymptotically normal as the sample size tends to infinity. Under this assumption, the maximum likelihood estimator for the sample occurrence rate is normally distributed

UNCLASSIFIED

about the true rate. Since the true variance for the estimator is not known, a confidence interval about the true mean can be obtained by using the quantity

$$t = \frac{\sqrt{n-1}\,(\hat{\lambda} - \lambda)}{S}$$

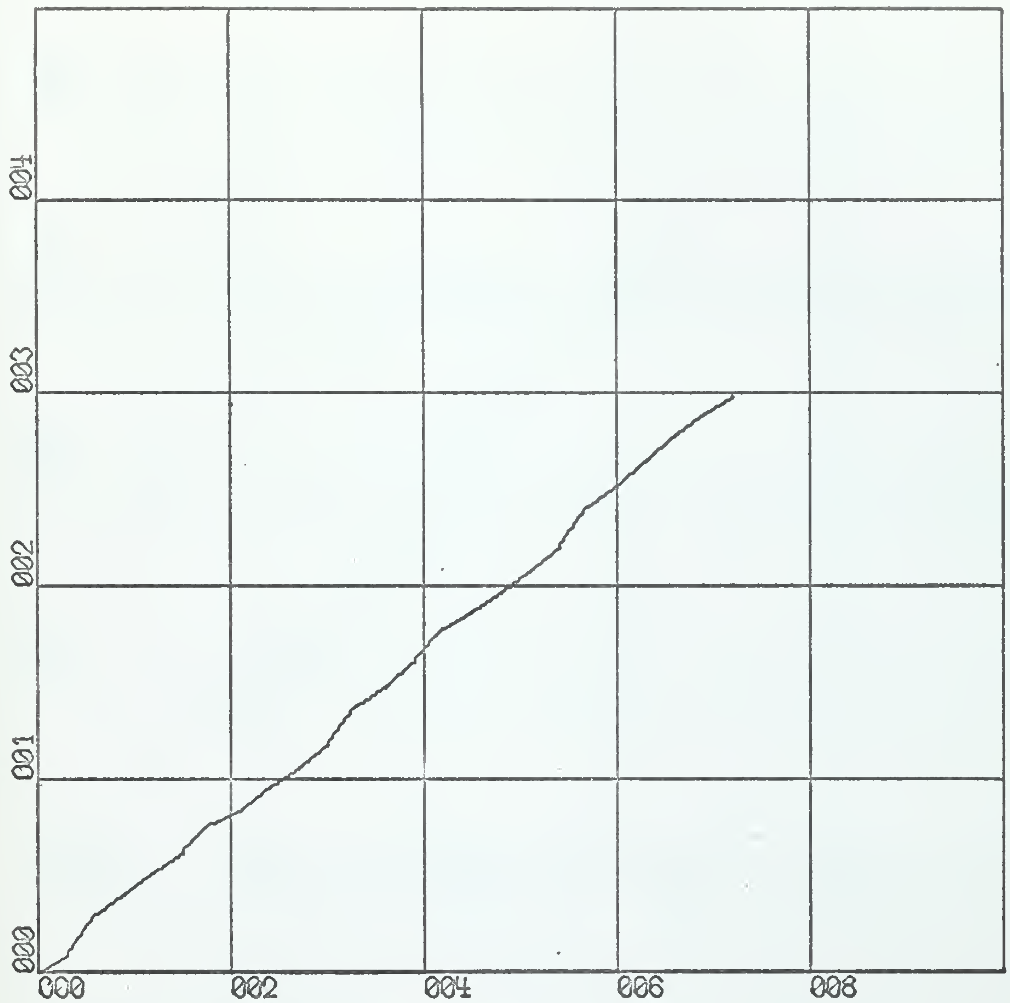
which has the t distributed with (n-1) degrees of freedom. $\hat{\lambda}$ is the same mean, S is the sample standard deviation, λ is the true accident occurrence rate, and n is the number of accidents. Therefore

$$\hat{\lambda} \pm t\left(\frac{\alpha}{2};\ n-1\right)\frac{S}{n-1}$$

gives a $(1-\alpha)$ confidence interval for the true aircraft accident rate λ.

The calculations for the combined fleets reveal that the true accident occurrence rate, with 90% confidence, lies between .37 and .45 accidents per day. A region of the same confidence level for the SIXTH FLEET shows the true accident occurrence rate between .08 and .12 accidents per day. The 90% confidence region for the true rate in the SEVENTH FLEET is from .12 to .16 accidents per day.

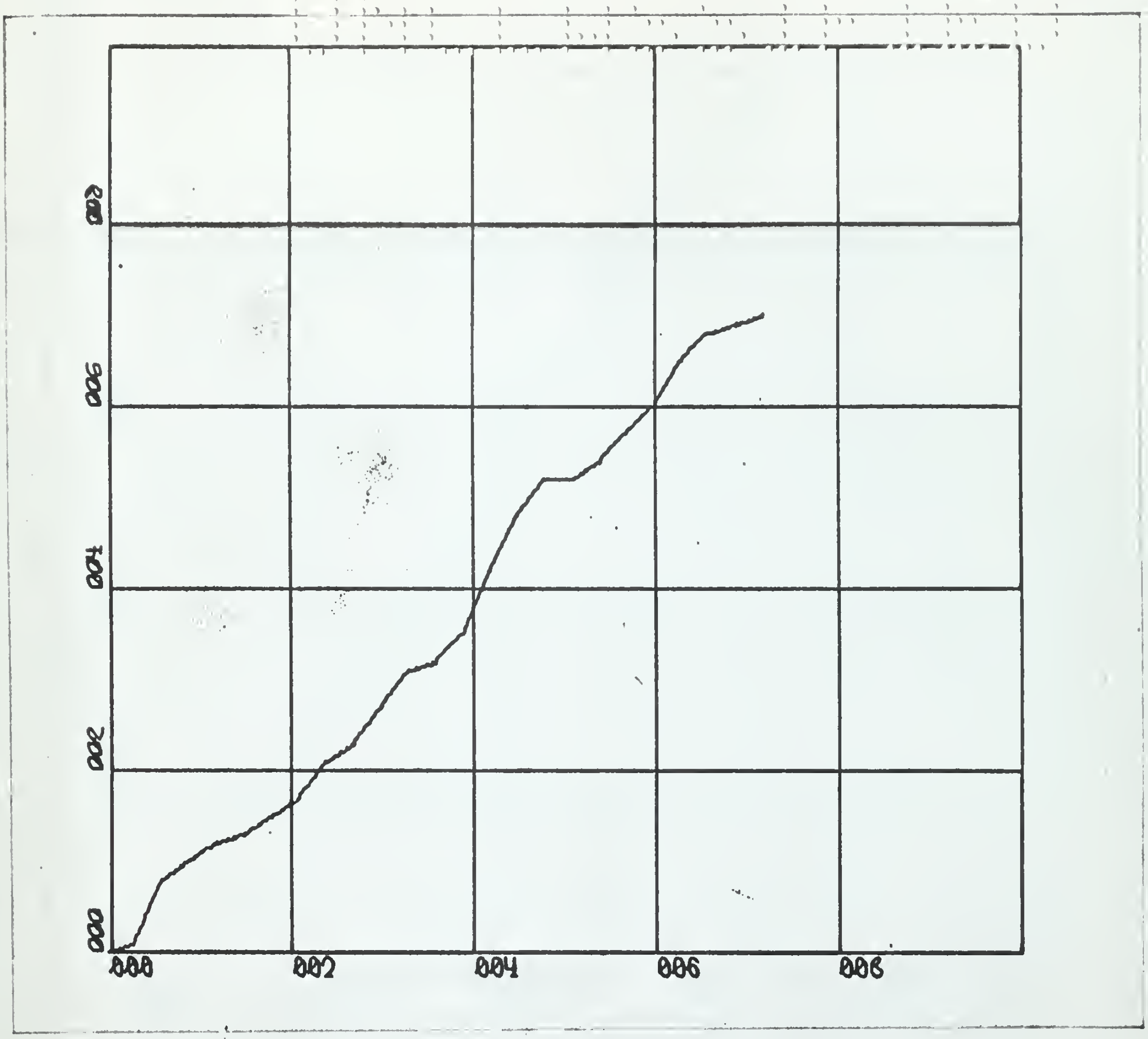
These accident occurrence rates for the SIXTH and SEVENTH FLEETS were compared in a two-tailed test of hypothesis to determine if significant difference existed between the two fleets. For a .05 level of significance, the results show a difference in performance. However, the results were not significant at the .01 level.



X - Scale = Days x 100
Y - Scale = Accidents x 100

Fig. 1a. Cumulative accidents since 1 January 1962, Combined Fleets

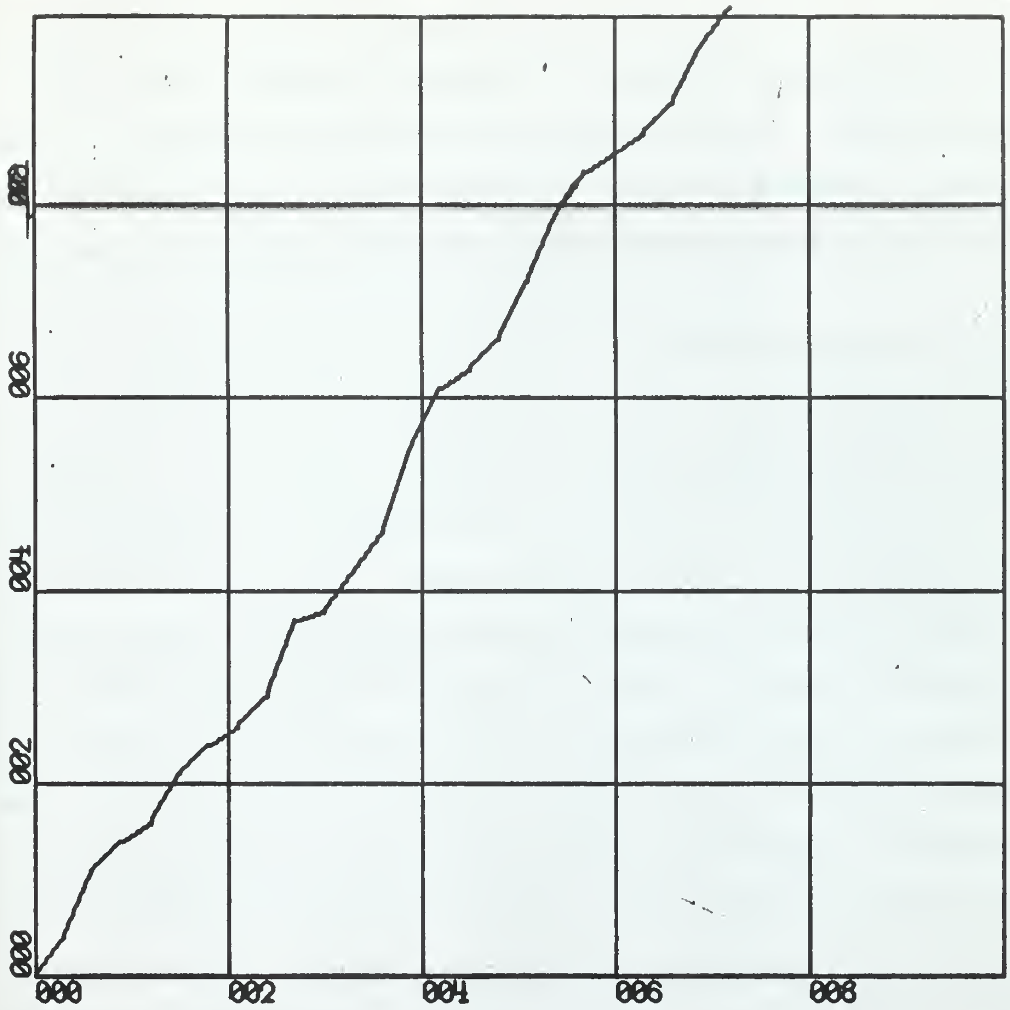
UNCLASSIFIED



X-Scale=Days x 100

Y-Scale=Accidents x 10

Fig. 1b. Cumulative accidents since 1 January 1962, 6th FLEET



X-Scale=Days x 100
Y-Scale=Accidents x 10

Fig. 1c. Cumulative accidents since 1 January 1962, 7th FLEET

5. General Comparison of Deployed Fleet Operations

Table 1 shows selected variables for the SIXTH and SEVENTH FLEETS which were computed from the ship movement reports. Carrier Operating Days is defined as the number of days at sea while deployed. Enroute or transit time is included in total deployed time to permit analysis of aircraft accidents which occurred during these periods.

During calendar years 1962 and 1963, the SEVENTH FLEET suffered more aircraft accidents than the SIXTH FLEET. However, there were on the average 1.6 more CVA's operating with the SEVENTH FLEET, and the ratio of accidents to average number of deployed carriers shows the SIXTH FLEET with the higher rate. Other variables show that the SIXTH FLEET spent more time at sea per CVA on the average than did the SEVENTH FLEET, which may account for this difference. The ratio of accidents to carrier operating days indicates that the two fleets were very nearly the same. Since this ratio is a function of the number of CVA's deployed, the amount of time spent at sea and the number of accidents, it presents an effective measure of safety performance. This measure could be improved by using the number of days in which flight operations were actually conducted instead of Carrier Operating Days. The data available did not permit this breakdown.

Fig. 2 is a plot of length of periods in port versus frequency for the two fleets. The SIXTH FLEET plot is rather uniform for periods of one to seven days with an average length of 4.38 days. The SEVENTH FLEET shows more variation with modes at four and seven days. The average stay in port was 6.49 days.

Fig. 3 depicts length of at sea periods versus frequency. The major difference appears in periods at sea greater than nine days. The average length of time at sea for the SIXTH FLEET was 9.59 days. This figure was 9.97 days for the SEVENTH FLEET.

It is not clear from Figs. 2 and 3 whether significant difference existed in the operating schedules for the SIXTH and SEVENTH FLEETS. The two-sample Kolmogorov-Smirnov test, based on a distribution-free statistic D, tests the hypothesis that the two samples came from the same population. [1]. The two functions are accepted under the null hypothesis as coming from the same distribution if D is less than the critical value determined for some level of significance.

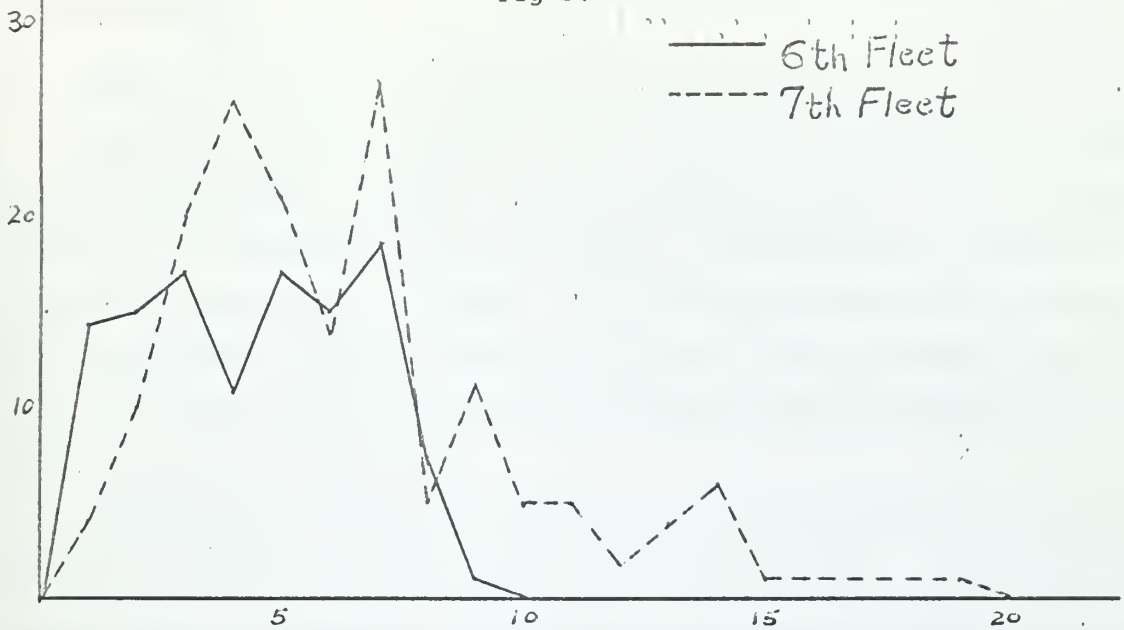
When the test was applied to the cumulative percentage distributions of length of periods at sea for the two fleets the maximum difference occurred at seven days giving a value for D of 16.9 percent. The critical value at the one percent level of significance was 19.0, indicating no difference in the distribution of length of at sea periods for the two fleets.

For length of periods in port the critical value at the one percent significance level was 19.7. The maximum difference in the cumulative percentage distributions was 21.8 which occurred for in port periods of eight days. Therefore the hypothesis that the two fleets had the same distribution for length of time in port must be rejected at this level.

Table 1

	SIXTH	SEVENTH
Number of Accidents	70.00	103.00
Average number of CVA's deployed	2.32	3.92
Number of Accidents/average number of CVA's deployed	30.17	26.28
Carrier Operating Days	1189.00	1805.00
Days in Port	504.00	1072.00
Carrier Operating Days/Days in Port	2.36	1.68
Percent Time at Sea	70.23	62.74
Percent time in Port	29.77	37.26
Number of Accidents/carrier operating days	.059	.057

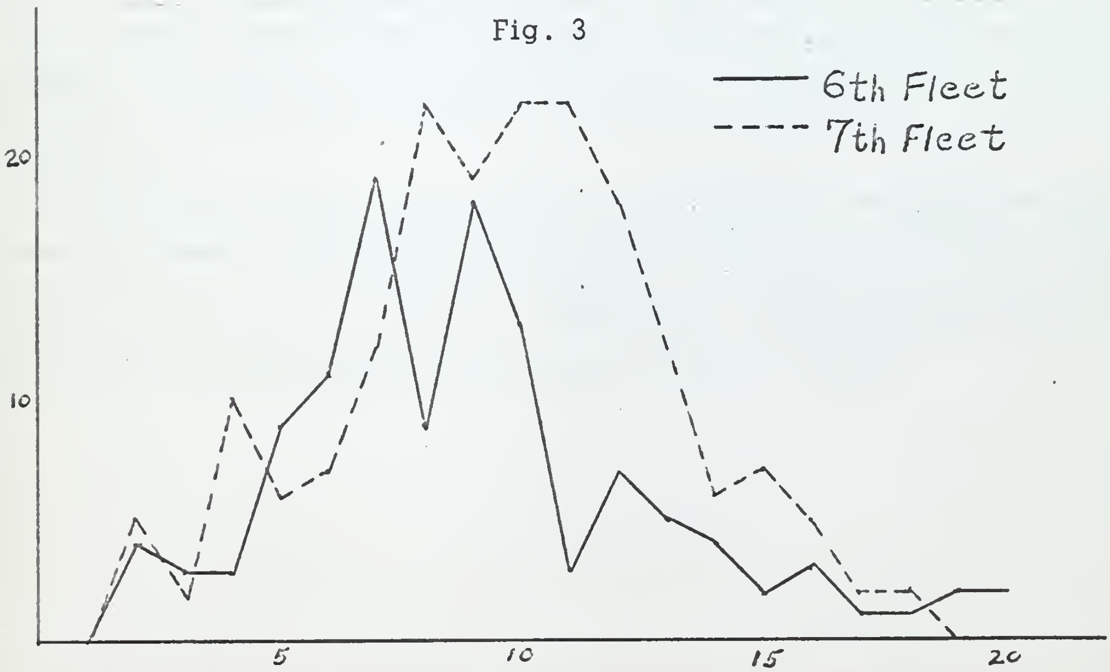
Fig 2.



X-Scale=Number of in port periods

Y-Scale=Length of in port periods (days)

Fig. 3



X-Scale=Number of at sea periods

Y-Scale=Length of at sea periods (days)

UNCLASSIFIED

6. General Comparison of Deployed CVA Operations.

Variables related to individual ship operations are contained in Table 2 for the SIXTH FLEET and Table 3 for the SEVENTH FLEET. CVA 11 was deployed at the beginning of the test period, 1 January 1962, and was reclassified upon return to CONUS. All other ships completed at least one full deployment, and some were also deployed at the beginning or the end of the test period. This accounts for the differing values of Carrier Operating Days and days spent in port.

The percentage of total accidents that occurred on deployment for the SIXTH and SEVENTH FLEETS were 60 and 56 respectively. A likelihood ratio test of these two Bernoulli populations can be used to test the null hypothesis that the two percentages did not differ significantly. [1]. Denoting the likelihood ratio by λ, the quantity $-2 \log \lambda$ has asymptotically the chi-square distribution with one degree of freedom. Application of the test showed the chi-square value to be .34. Since this is less than the critical value of .455 at the .5 level, the hypothesis is accepted that two fleets showed no significant difference in percent of accidents that occurred on deployment.

The fraction of time spent at sea for each CVA was compared with the same frequency for its parent fleet using the likelihood ratio test. The results show that at a .1 level of significance, the time spent at sea by each CVA was consistent with its parent fleet as a whole.

Table 2

	CVA 11	38	42	59	60	62	65
Carrier Operating Days	38	197	165	155	241	193	200
Days in Port	22	97	56	58	102	86	83
Percent time at Sea	63.3	67.0	74.7	72.8	70.3	69.2	70.7
Percent time in Port	36.7	33.0	25.3	27.2	29.7	30.8	29.3
Number of Accidents while deployed	0	16	11	11	14	8	10
Number of Accidents/Carrier operating days	.000	.0812	.0667	.0710	.0581	.0415	.0500
Total Number of Accidents	0	25	18	23	18	17	16
Percent of Accidents that occurred on deployment	0	64.0	61.1	47.8	77.8	47.1	62.5

Table 3

	CVA 14	16	19	31	34	41	43	61	63	64
Carrier Operating Days	132	118	269	142	193	157	276	165	169	184
Days in Port	76	64	123	76	154	95	159	120	109	96
Percent time at sea	63.5	64.8	68.6	65.1	55.6	62.3	63.5	57.9	60.8	65.7
Percent time in port	36.5	35.2	31.4	34.9	44.4	37.7	36.5	42.1	39.2	34.3
Number of Accidents while deployed	9	6	12	9	10	21	11	11	5	9
Number of Accidents/carrier operating days	.0682	.0508	.0446	.0634	.0518	.1338	.0399	.0667	.0296	.0489
Total number of Accidents	22	9	26	17	20	36	13	17	7	16
Percent of accidents that occurred on deployment	40.9	66.7	46.2	52.9	50.0	58.3	84.6	64.7	71.4	56.3

7. Distribution of Accidents on Deployment

The period of time during a deployment in which accidents are most likely to occur would be valuable information if it could be accurately predicted. However, many complex variables such as weather, type of operations, proficiency of all involved personnel and many other operating conditions present themselves.

Figs. 4a and 4b represent the deployments for 1962 and 1963 for the CVA's operating with the SIXTH and SEVENTH FLEETS.

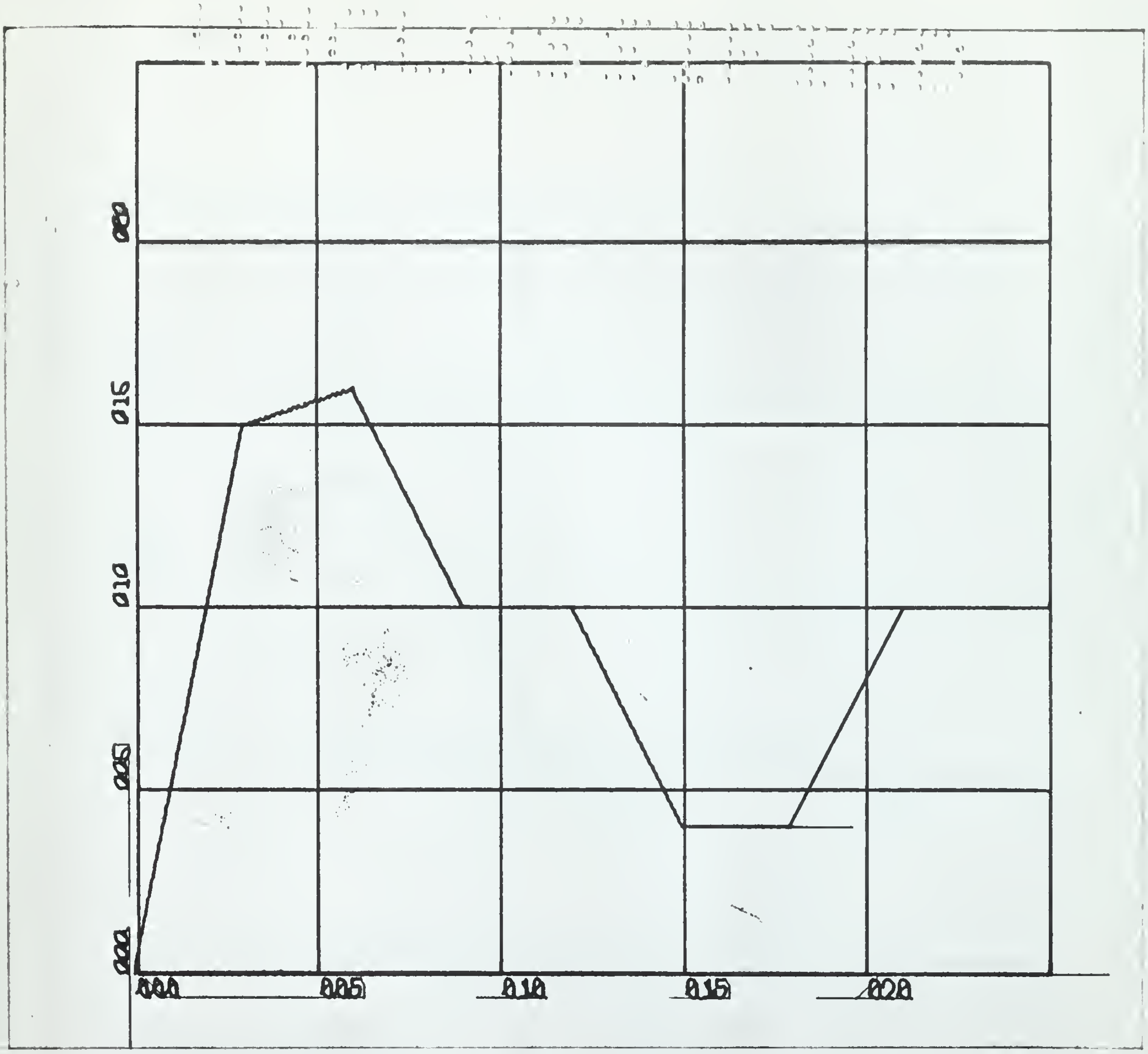
In general, most of the accidents occurred within the first two months and gradually declined as the cruise progressed, which is reasonable since the pilots and carrier personnel become more proficient with time. However, a definite rise occurred in both fleets toward the end of the deployment periods. This rise started after about four months for the SEVENTH FLEET and after about six months for the SIXTH FLEET. Sufficient data was not available to accurately account for this rise in accidents. In general, the two fleets appeared to suffer accidents in a similar manner on deployment. The K-S(Kolmogorov-Smirnov) test indicates no significant difference in the cumulative percentage distributions for the two fleets at the .01 level. The largest difference occurred at 180 to 210 days as the number of accidents in the SIXTH FLEET showed a rise where the SEVENTH FLEET showed a slight decrease.

Figs. 5a and 5b show accidents as a function of the number of days at sea since beginning the deployment. Both fleets experienced a mode at less than 20 days, which includes the period enroute to the area of deployment. Other sample modes appear at similar times for the two fleets, but the general pattern decreases with time. It has been shown that the carriers spend between 60 and 70 percent of their deployed time at sea, including the enroute time. For a normal length cruise of six to

to seven months on station, the cruise would terminate after 120 to 140 operating days. The SIXTH FLEET had a positive rate of accident occurrence during this time, while the SEVENTH FLEET experienced a continued decrease, although at a lesser rate.

The K-S test again shows no difference in the cumulative percentage distributions for the two fleets at the .01 level of significance. The largest difference in the distributions for the two fleets occurred at 120 to 135 days.

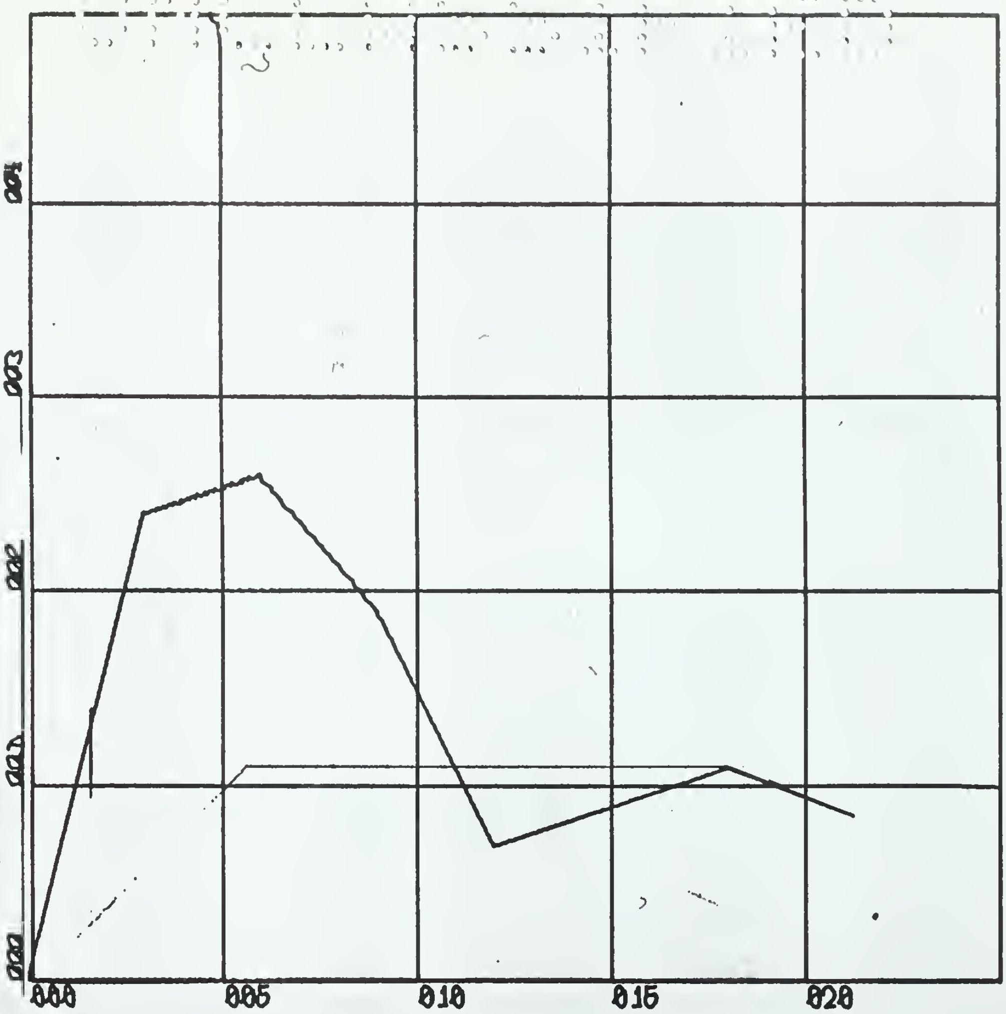
UNCLASSIFIED



X-Scale=Days x 10

Y-Scale=Accidents

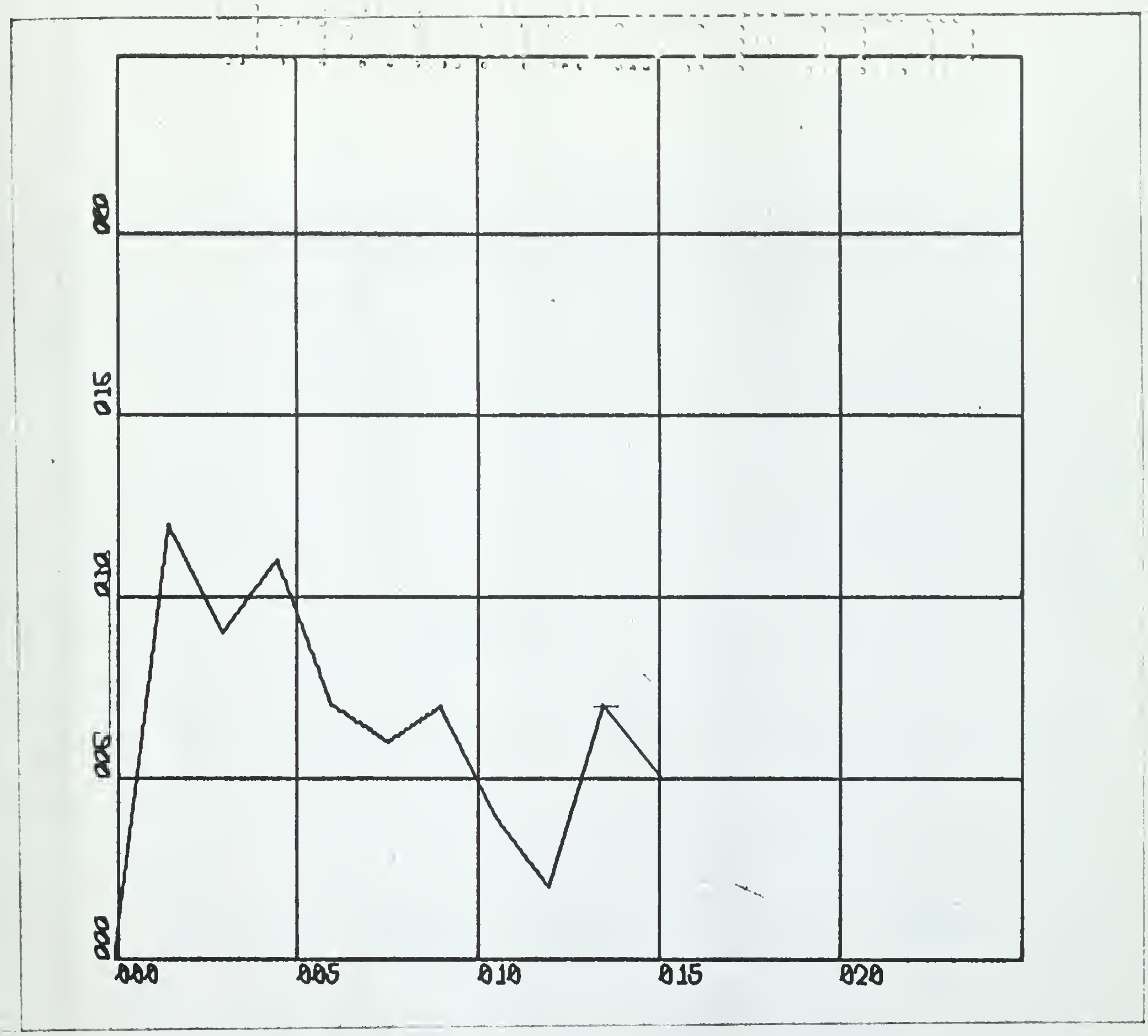
Fig. 4a. Time since beginning of deployment until accident, 6th FLEET



X-Scale=Days x 10

Y-Scale=Accidents

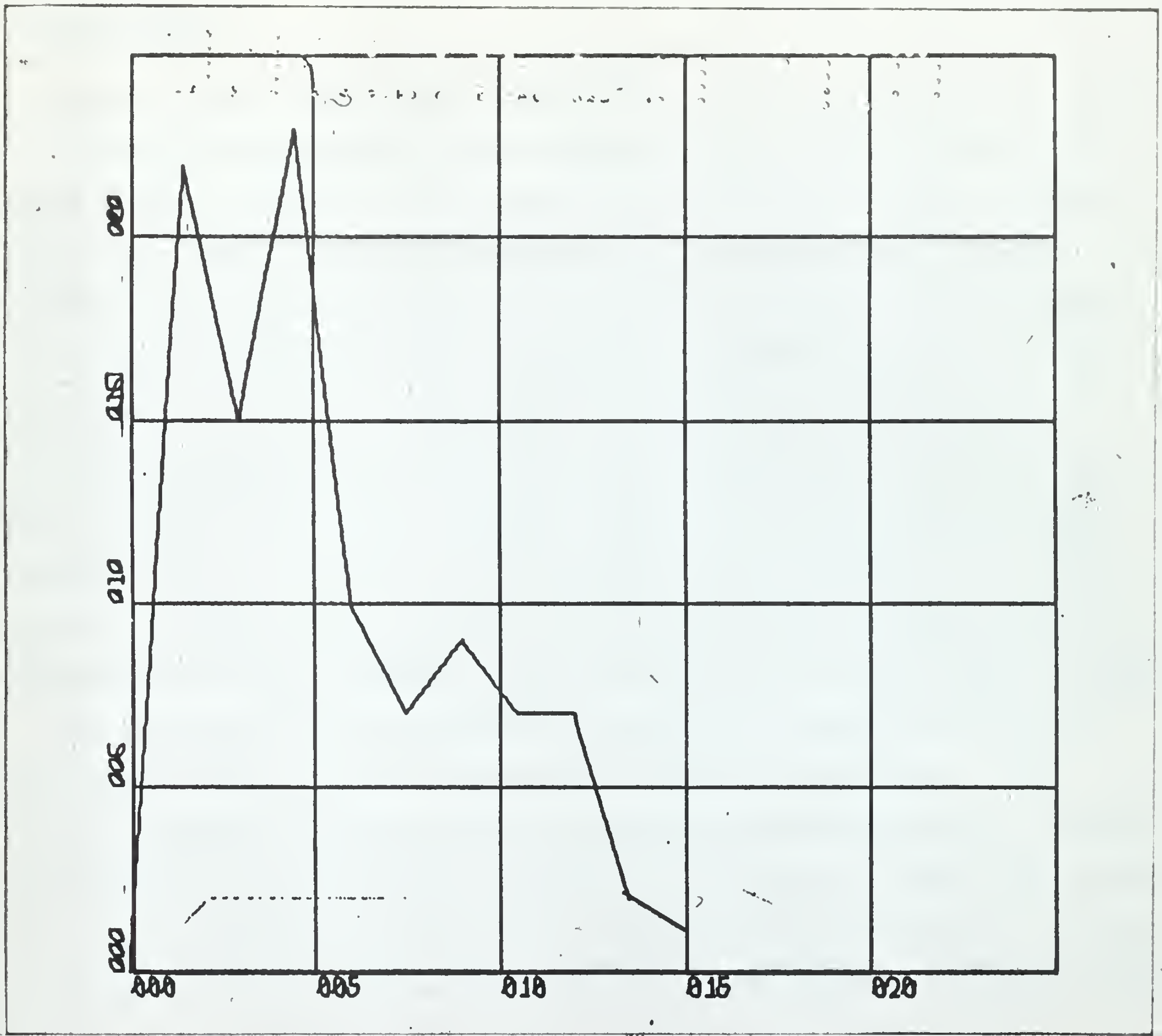
Fig. 4b. Time since beginning of deployment until accident, 7th FLEET.



X-Scale=Days x 10

Y-Scale2Accidents

Fig. 5a. Time at sea since beginning of deployment until accident, 6th FLEET.



X-Scale=Days x 10
Y-Scale=Accidents

Fig. 5b. Timé at sea since beginning of deployment until accident, 7th FLEET.

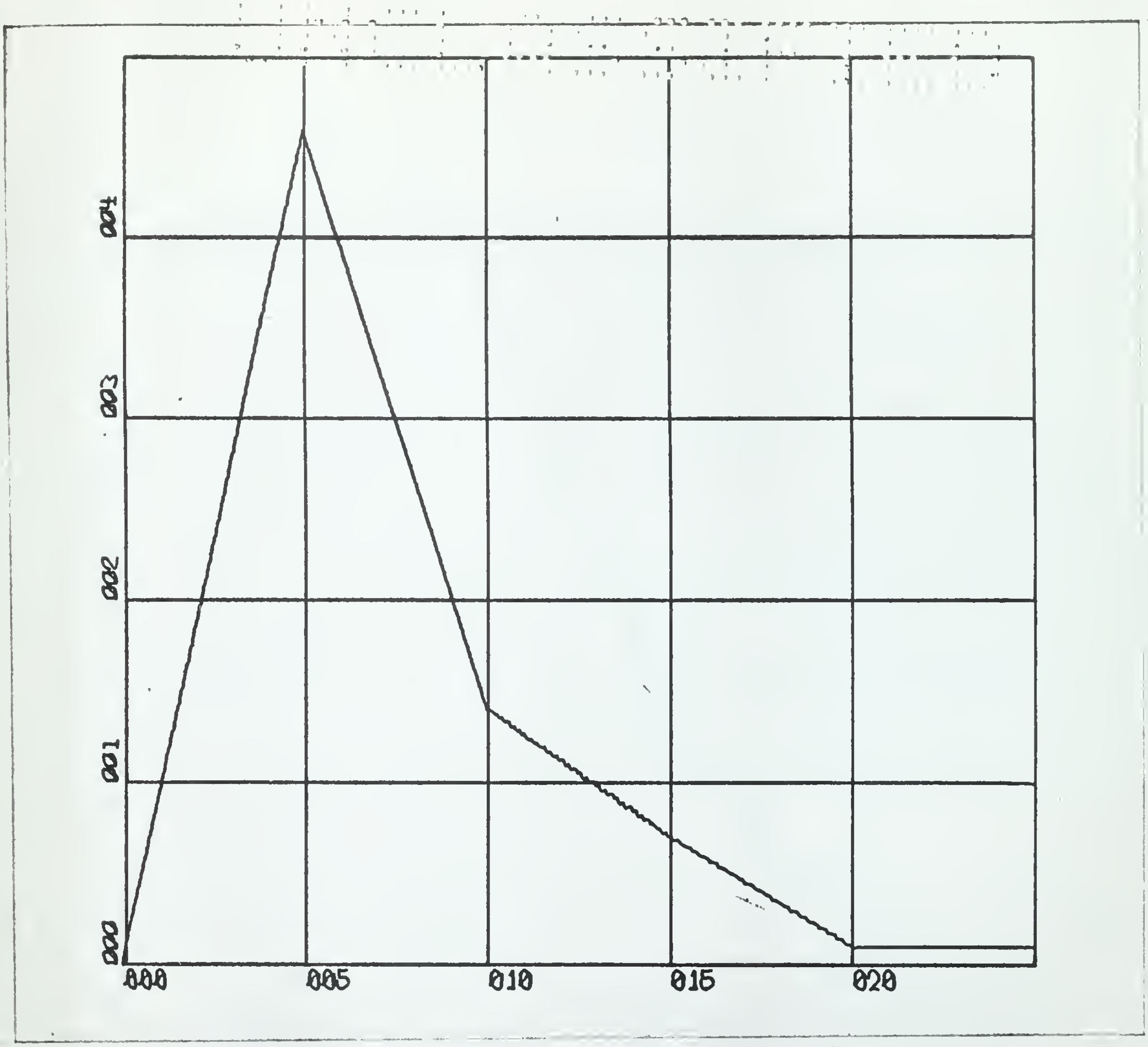
8. Length of Time at Sea Prior to Accident.

Analysis of the occurrence of accidents during operating periods indicates that most mishaps were recorded within the first five days at sea for both fleets. Fig. 6a shows this frequency of occurrence for the SIXTH FLEET. With an average time spent at sea of 9.59 days, a mode occurred at five days. Afterwards, the rate decreased sharply to ten days and then continued to decrease at a lesser rate. The SEVENTH FLEET, with an average time spent at sea of 9.97 days, also experienced a mode at five days as shown in Fig. 6b. However, almost as many accidents occurred between five and ten days at sea as within the first five days. The distribution of accidents after ten days at sea for both fleets showed a decrease because the number of periods at sea was less than ten days on the average.

The K-S test on the two cumulative distributions showed that the two distributions did not differ significantly at the one percent level. The largest difference occurred during the period from one to five days, with the SIXTH FLEET having the higher percentage. The manner in which flight operations are conducted during the first few days out of port varies with the fleet involved, the length of the in port period, and the particular operating requirements.

In order to examine the effect of the length of in port periods on the number of days out of port until the accident occurred, sample correlation coefficients were calculated for these two variables. If the true nature of accident occurrence were such that the longer a ship remained in port the sooner the accident would occur after putting to sea, the expected correlation should approach -1.0. The calculated correlations do not conform to this theory. The SIXTH FLEET sample correlation coefficient of .408 indicates a positive relationship between length of time in port and length of time at sea prior to an accident. The SEVENTH FLEET sample correlation was -.065. In this case the correlation was negative but was very near zero. For large sample

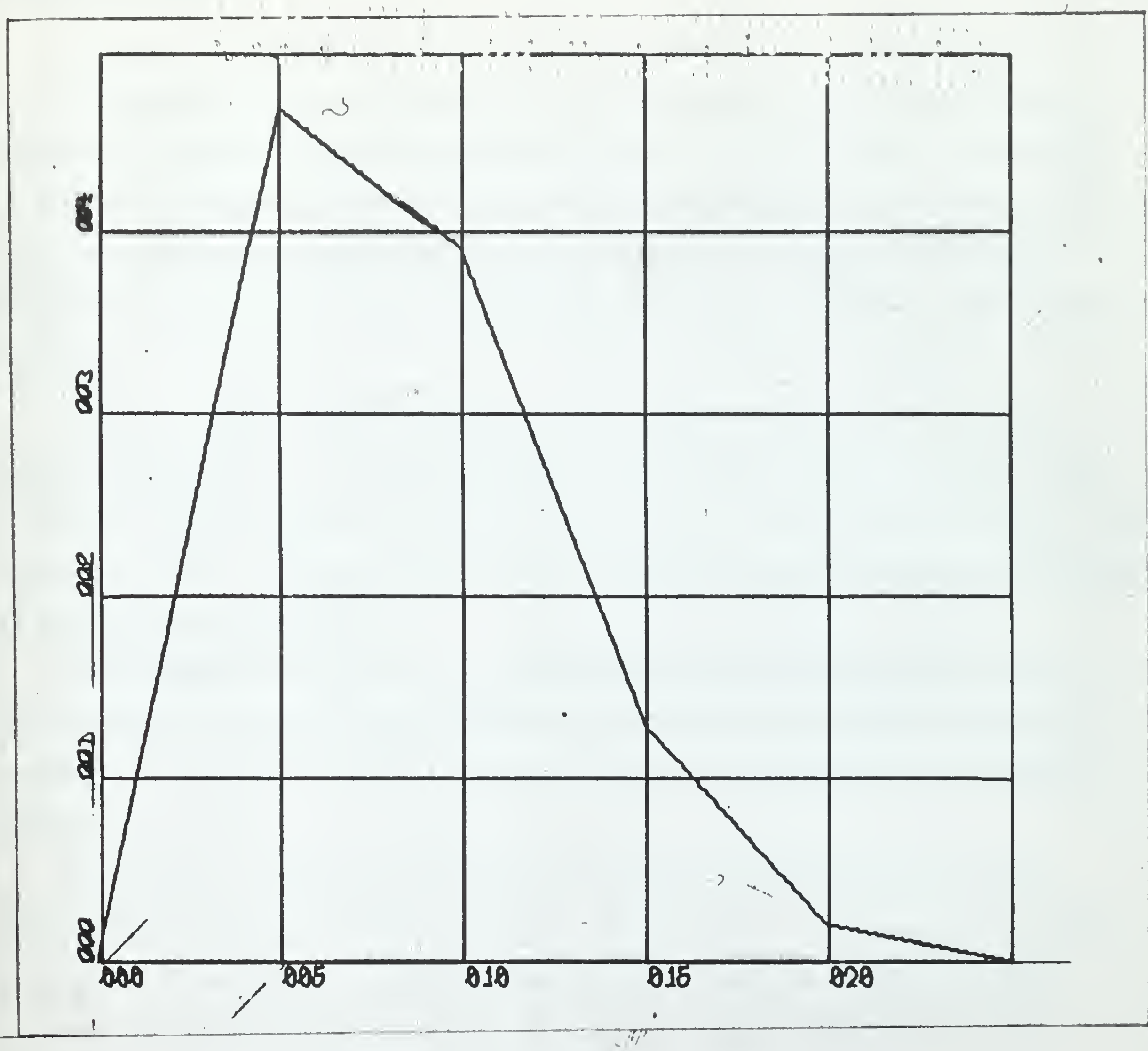
sizes, the sample correlation coefficient becomes asymptotically normal. Under this assumption a two tailed test of the hypothesis that the true SEVENTH FLEET correlation is zero resulted in acceptance at the .05 significance level indicating that the two variables may be considered independent. The difference in the two correlation coefficients is partially explained by noting that the distributions of the number of days at sea prior to an accident for both fleets are not significantly different, while the distributions for the length of in port periods were shown to differ at the .01 significance level. However, no intuitive reason is apparent to justify this difference.



X-Scale=Days

Y-Scale=Accidents x 10

Fig. 6a. Time at sea immediately prior to accident, 6th FLEET.



X-Scale=Days

Y-Scale=Accidents x 10

Fig. 6b. Time at sea immediately prior to accident, 7th FLEET.

UNCLASSIFIED

9. Phase of Operation.

A breakdown of aircraft accidents into the phase of operation[5] during which the accident occurred is shown in Figs. 7a, 7b and 7c. Almost 49% of the 300 combined fleet accidents happened during the landing phase and 60% occurred either during the landing or waveoff. Takeoff and inflight accidents were nearly equal at about 17% each. Fig. 7a shows these distributions.

Of the 70 SIXTH FLEET accidents, the largest number also occurred during landing, Fig. 7b. Thirty-seven percent were landing accidents and 46% were either landing or waveoff, which shows a reduction compared to the combined fleets. However, 27% of the accidents occurred inflight and almost 22% happened on takeoff.

The SEVENTH FLEET, Fig. 7c, followed the same pattern with 48% of the accidents occurring during the landing phase and 64% either landing or waveoff. Takeoff and inflight accidents accounted for 18% and 14% respectively.

In general, most of the accidents occurred during landing with the SIXTH FLEET having the least percent in this phase. The second most common phase of accident occurrence was inflight, and the deployed fleets showed an increase over the combined fleets. Static and taxi phases accounted for approximately 5% in all cases.

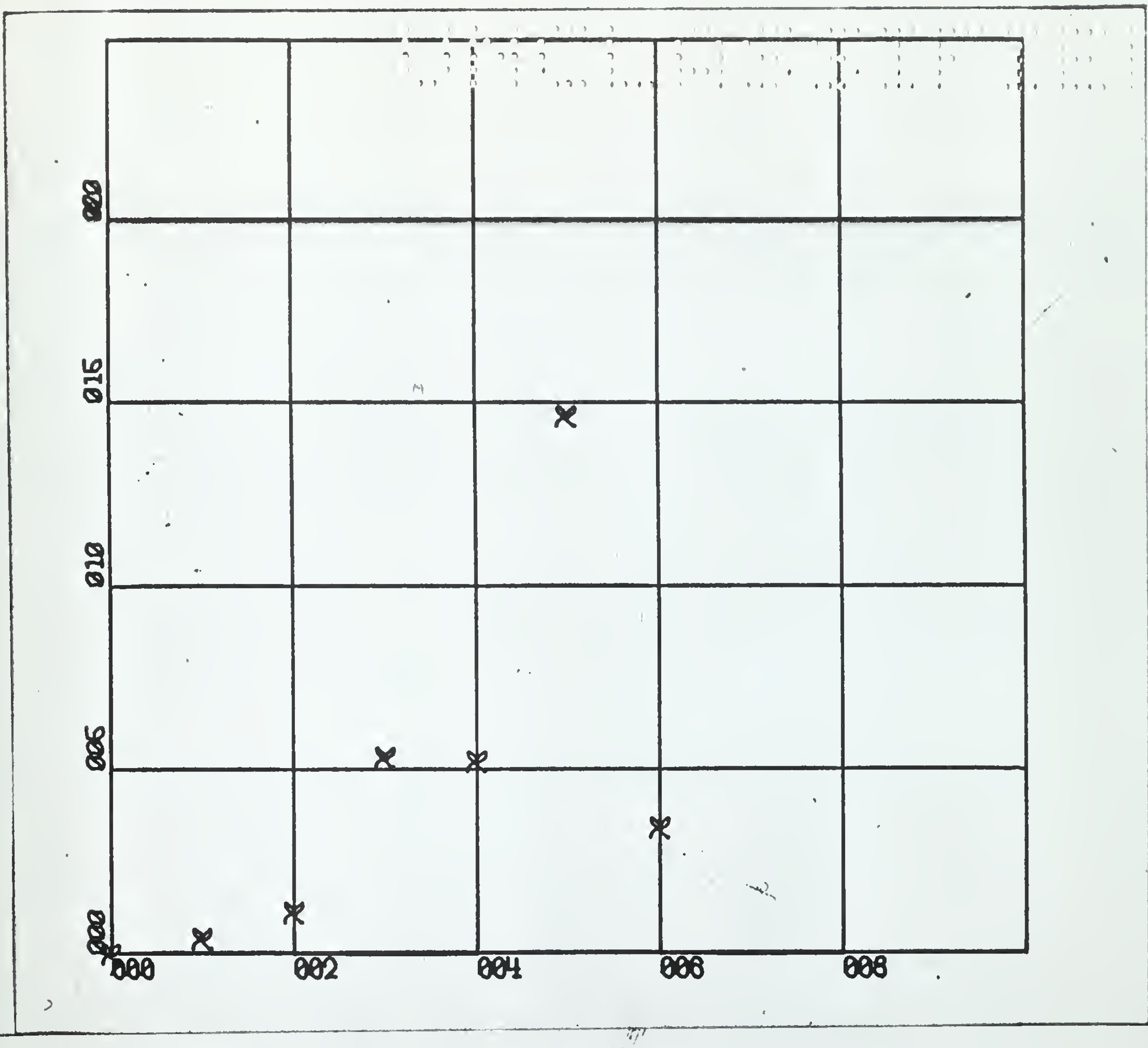
In order to compare the fleets a likelihood ratio test was constructed for the combined landing and waveoff phases, which accounted for most of the accidents. The results for the combined fleets and the SIXTH FLEET

---

[5] U. S. Naval Aviation Safety Center. Manual of Code Classifications for Navy Aircraft Accident, Incident and Ground Accident Reporting, July, 1963: 29-38.

showed a significant difference at the .05 level with the SIXTH FLEET having the fewer accidents in these phases. The SEVENTH FLEET compared favorably with the combined fleets showing no difference at the .05 significance level. A comparison of the SIXTH and SEVENTH FLEETS showed significant difference at the .05 level with the SIXTH FLEET again having fewer accidents in the landing and waveoff phases.

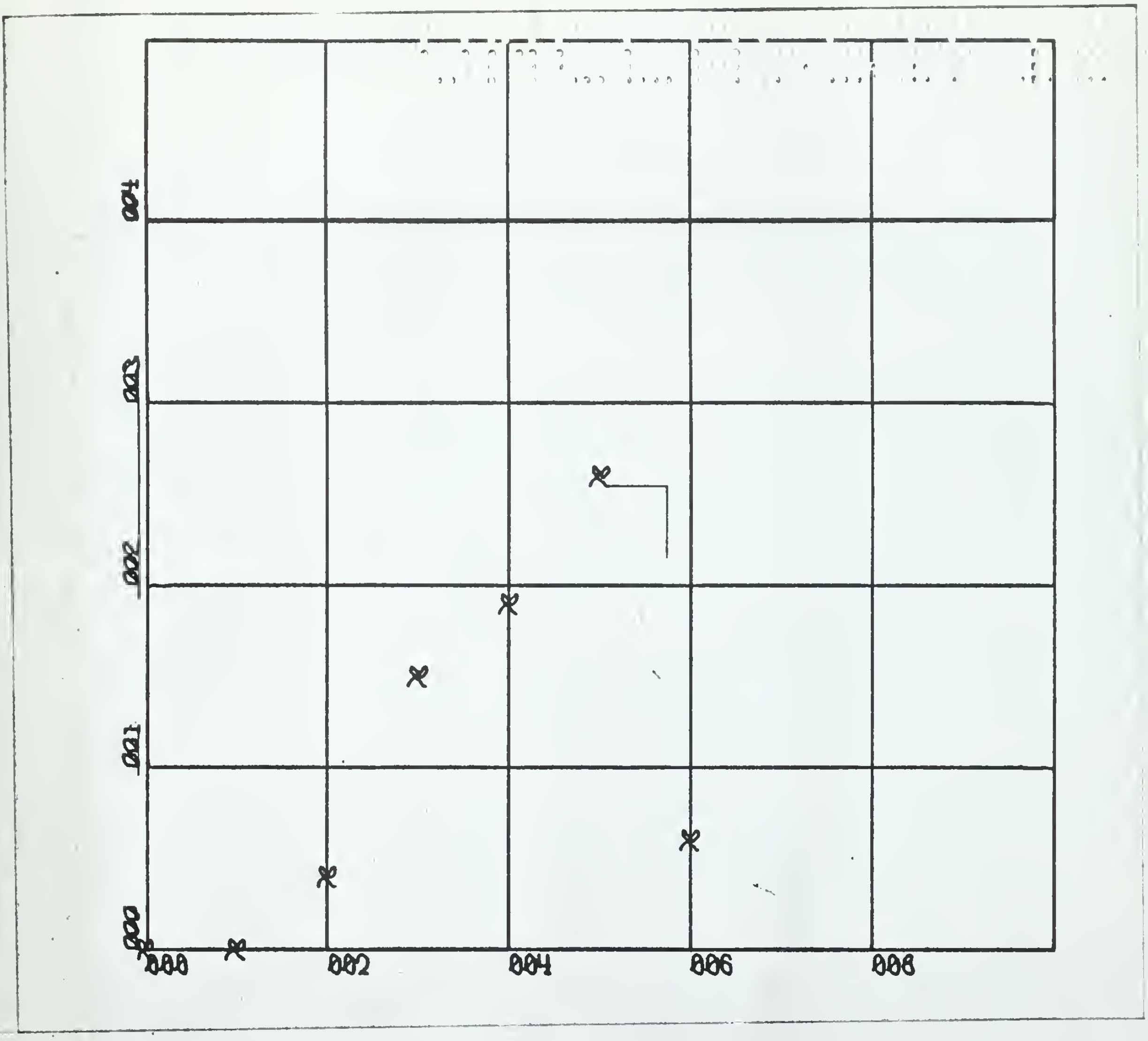
A comparison of the combined, SIXTH and SEVENTH FLEETS accident phase distributions was made for all the phase types using the two-sample K-S test. Although designed for continuous data, this test is applicable to discrete distributions such as those shown in Figs. 7a, 7b and 7c. [3]. A significant difference exists between the combined fleets and the SIXTH FLEET, and also between the SIXTH FLEET and the SEVENTH FLEET at the .1 level. The phases of maximum difference were inflight, where the SIXTH FLEET had more accidents than the other two, and landing, which showed the SIXTH FLEET with fewer accidents than the SEVENTH FLEET or the combined fleets.



X-Scale: 0=Undetermined
1=Static, incident to flight
2=Taxiing, incident to flight
3=Takeoff
4=Inflight
5=Landing
6=Waveoff

Y-Scale=Accidents x 10

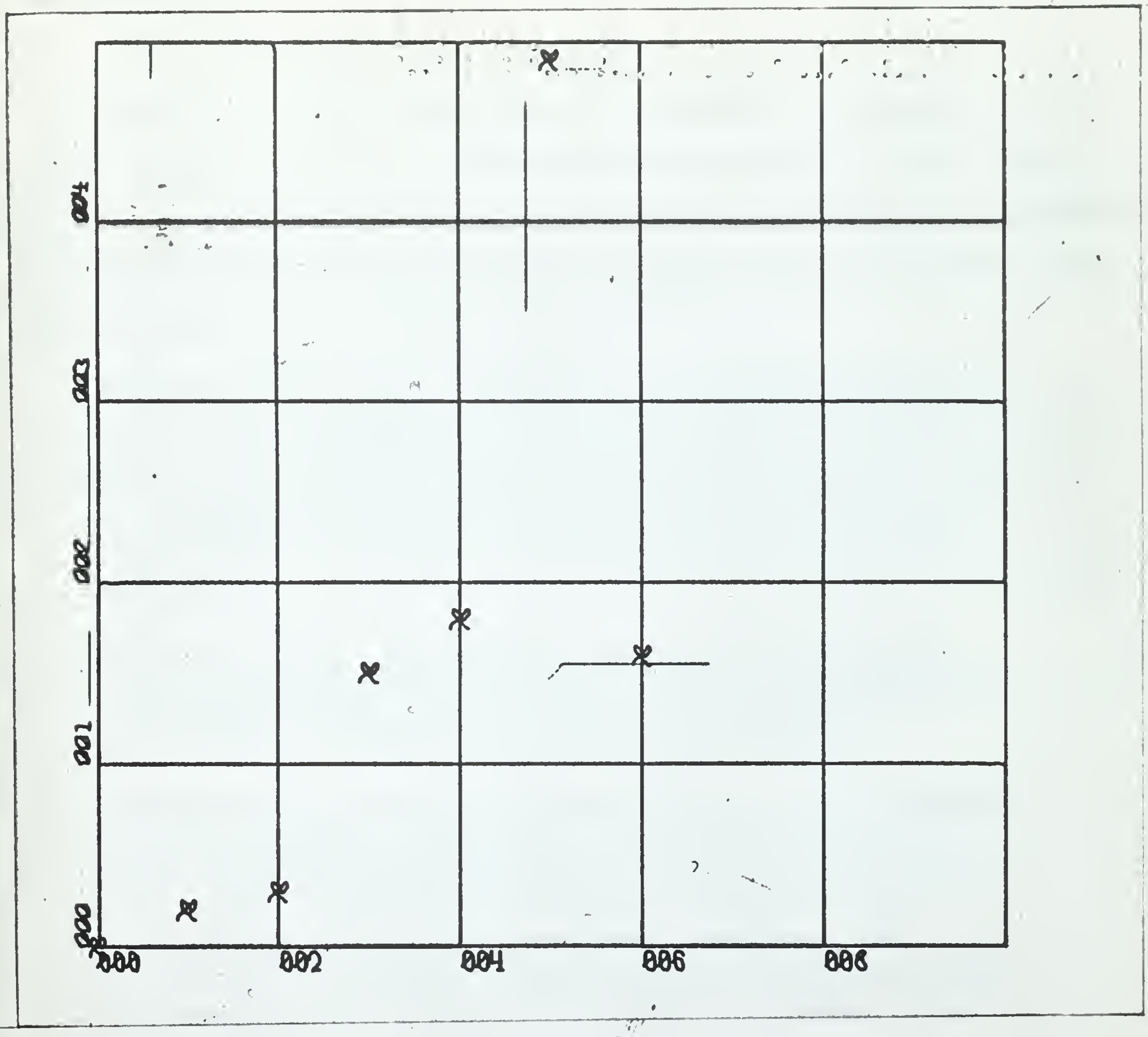
Fig. 7a. Phase of operation, Combined Fleets.



X-Scale: 0=Undetermined
1=Static, incident to flight
2=Taxiing, incident to flight
3=Takeoff
4=Inflight
5=Landing
6=Waveoff

Y-Scale=Accidents x 10

Fig. 7b. Phase of operation, 6th FLEET.



X-Scale: 0=Undetermined
1=Static, incident to flight
2=Taxiing, incident to flight
3=Takeoff
4=Inflight
5=Landing
6=Waveoff

Y-Scale=Accident x 10

Fig. 7c. Phase of operation, 7th FLEET

10. Accident Damage and Cause Factors

Figs. 8a, 8b and 8c present aircraft accidents as a function of pilot injury, aircraft damage and selected cause factors for the various fleets. Fatal injuries are those resulting in death within 30 days after the accident. Unknown injuries are those in which the remains were not recovered. Aircraft accident damage is defined as follows[6]:

> ALFA-Destruction, loss or damage to the aircraft which renders the aircraft of no further value except for possible salvage of parts. . . This classification does not include repairable aircraft which must be surveyed because of inaccessible location, current limitations on manhours or funds allowable for the repair of the aircraft, or aircraft is striken for other administrative reasons.
>
> BRAVO-Aircraft damage sustained which is so extensive that a standard rework at an O & R facility or at a contractor's plant is necessary to restore the aircraft to serviceability.
>
> CHARLIE-Aircraft damage sustained which does not necessitate a standard rework. . . when (1) The total direct manhours required to effect complete repairs to the aircraft exceeds the minor damage limits established for the various models of aircraft as listed in enclosure (5) of (OPNAVINST 3750.6E). (2) Destruction or damage beyond economical repair to a major component requiring its removal and replacement with a new component.

During the two year span of this study, 69 accidents in the combined fleets resulted in fatal or unknown injuries. Thirty three percent of these occurred in the SIXTH FLEET and 35% in the SEVENTH FLEET. One accident in three resulted in fatality in the SIXTH FLEET while the SEVENTH FLEET suffered one in four on the average.

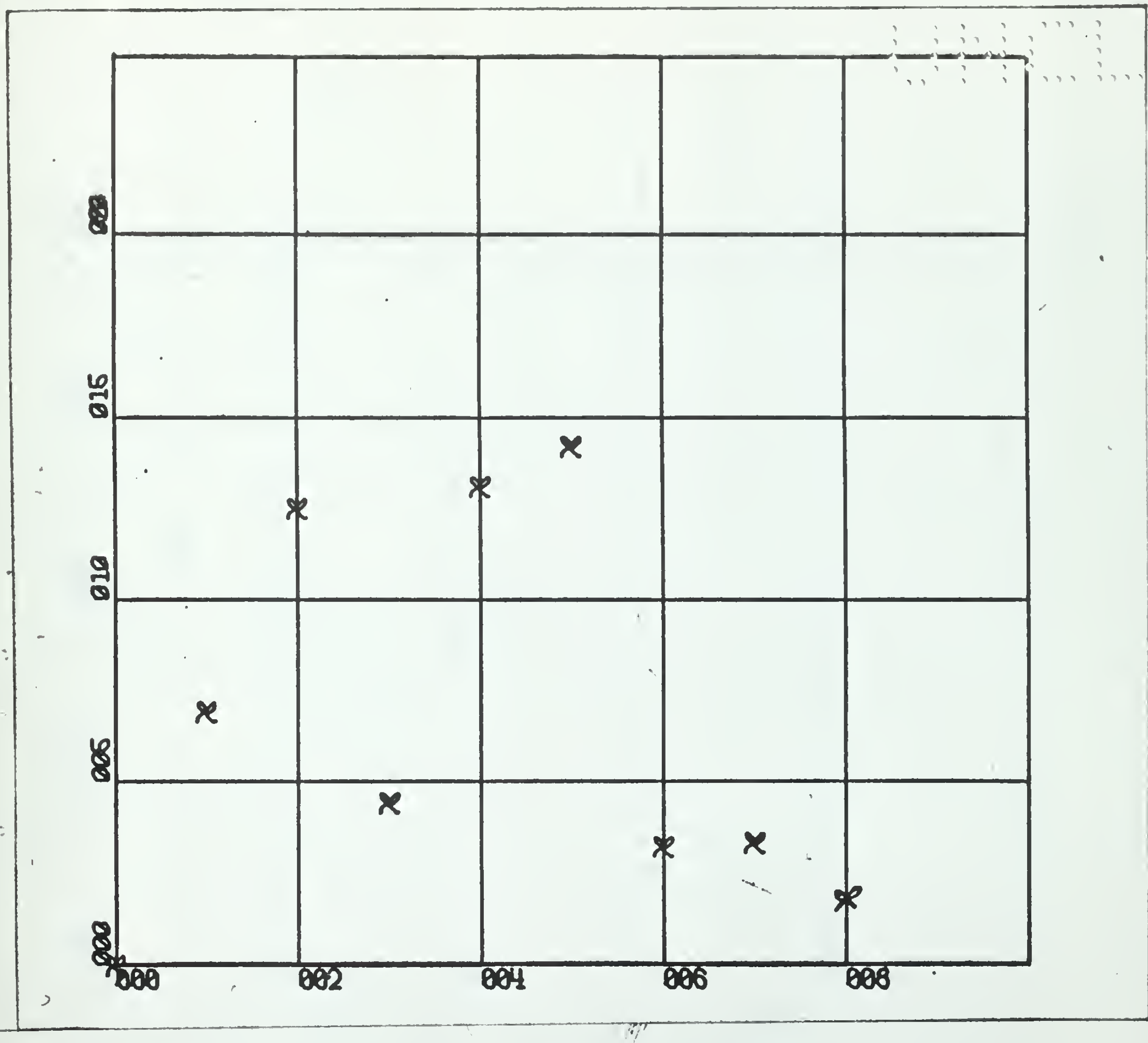
---

[6] U.S. Naval Aviation Safety Center. Manual of Code Classifications for Navy Aircraft Accident, Incident and Ground Accident Reporting, July, 1963:3.

Aircraft damage for each of the fleets shows BRAVO damage a less frequent classification in all cases. The K-S test of the cumulative percentage distributions for accident classification resulted in no significant difference in the combined fleets and the SEVENTH FLEET at the .1 level. However, the SIXTH FLEET was significantly different when compared to the combined fleets or the SEVENTH FLEET at this level.

Pilots were listed as contributing cause factors in almost half the accidents for each of the fleet categories. This indicates pilot's actions contributed to the occurrence and extent of damage, and that they were not necessarily the sole causal factor. However, these high percentages indicate an area which could substantially lower the number of accidents if the pilot factor were reduced.

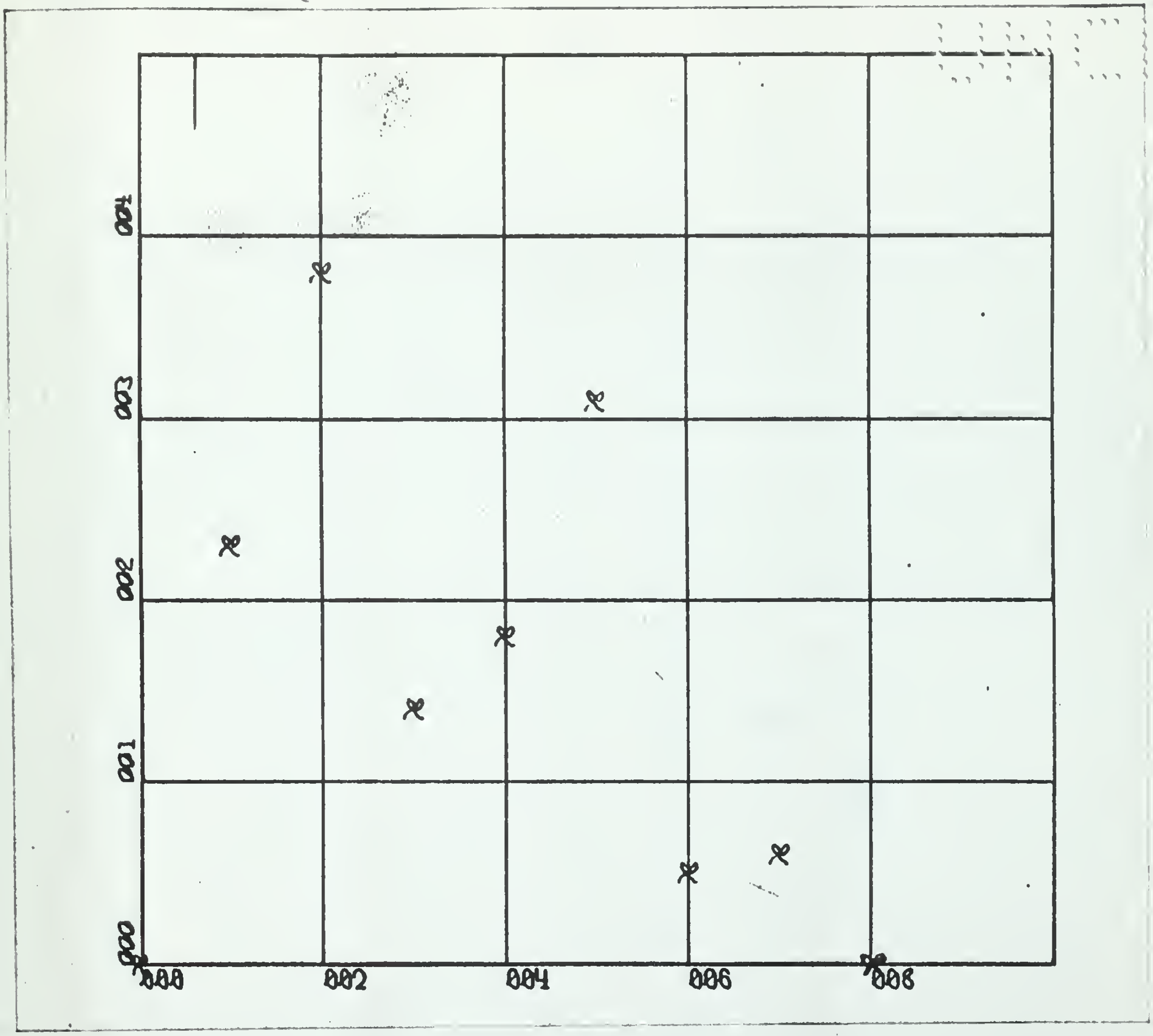
The extent of ship participation in accident causation was examined in three categories. It was found that the LSO was listed as a contributing cause factor in 11% of the combined fleet accidents, 13% for the SEVENTH FLEET and 7% for the SIXTH FLEET. The CVA was reported as a contributing factor in 12% of the combined fleet accidents, 13% for the SEVENTH FLEET and 9% for the SIXTH FLEET. No significant differences existed in these areas between the two deployed fleets or the combined fleets at the .1 level. Pitching deck was a cause factor in 6% of the combined fleet accidents, 8% of the SEVENTH FLEET, and none of the SIXTH FLEET accidents. Sufficient data was not available for a comparison of the total amount of operations which were conducted under conditions involving pitching decks and any conclusions concerning a fleet's performance under these conditions would not be factual.



X-Scale: 1=Fatalities or unknowns
2=ALFA damage
3=BRAVO damage
4=CHARLIE damage
5=Pilot as a cause factor
6=LSO as a related variable
7=CVA as a contributing cause factor
8=Pitching deck as a contributing cause factor

Y-Scale=Accidents x 10

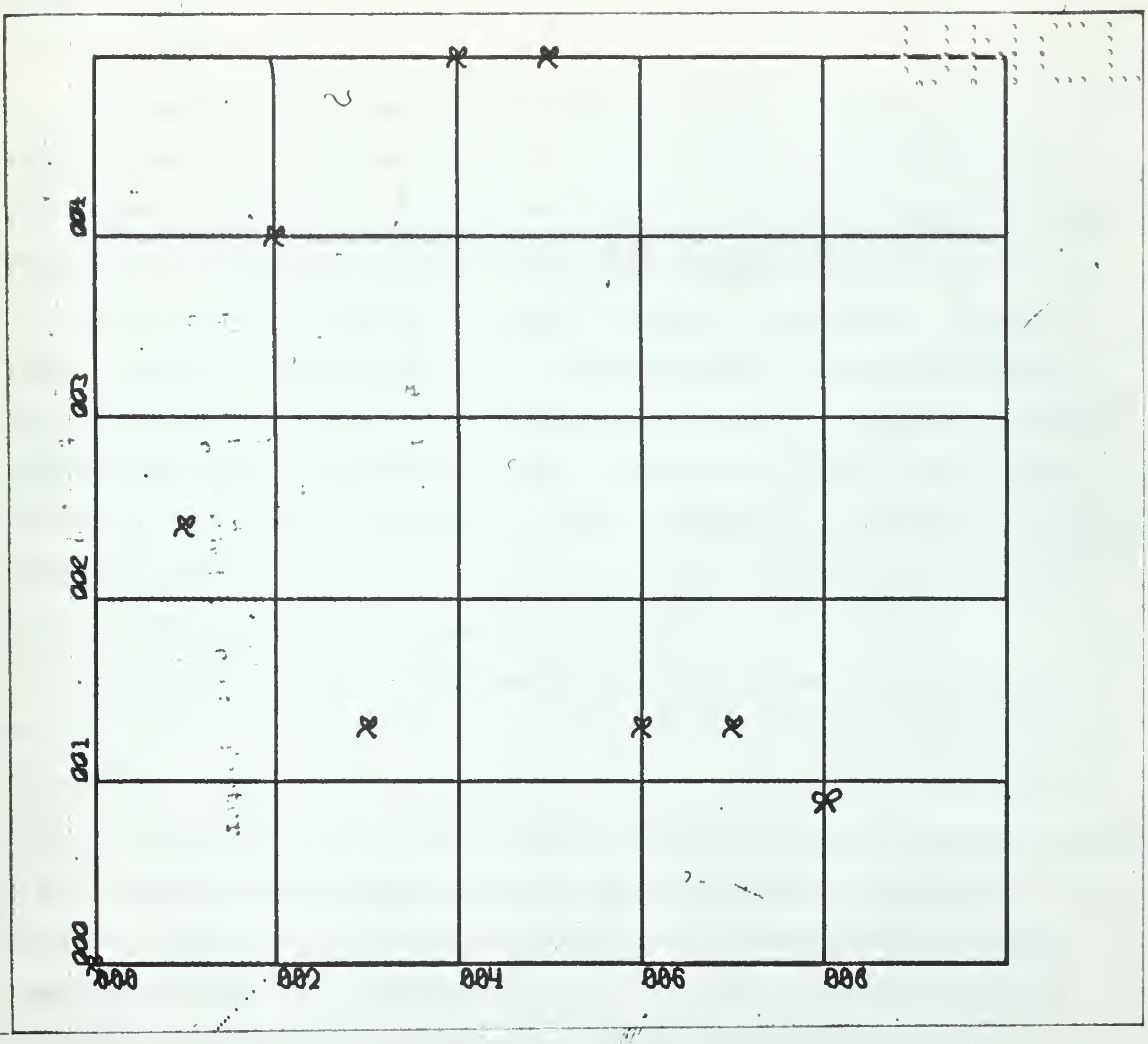
Fig. 8a. Damage and cause factors, Combined Fleets.



X-Scale: 1=Fatalities or unknowns
2=ALFA damage
3=BRAVO damage
4=CHARLIE damage
5=Pilot as a cause factor
6=LSO as a related variable
7=CVA as a contributing cause factor
8=Pitching deck as a contributing cause factor

Y-Scale=Accidents x 10

Fig. 8b. Damage and cause factors, 6th FLEET



X-Scale: 1=Fatalities or unknowns
2=ALFA damage
3=BRAVO damage
4=CHARLIE damage
5=Pilot as a cause factor
6=LSO as a related variable
7=CVA as a contributing cause factor
8=Pitching deck as a contributing cause factor

Y-Scale=Accidents x 10

Fig. 8c. Damage and cause factors, 7th FLEET.

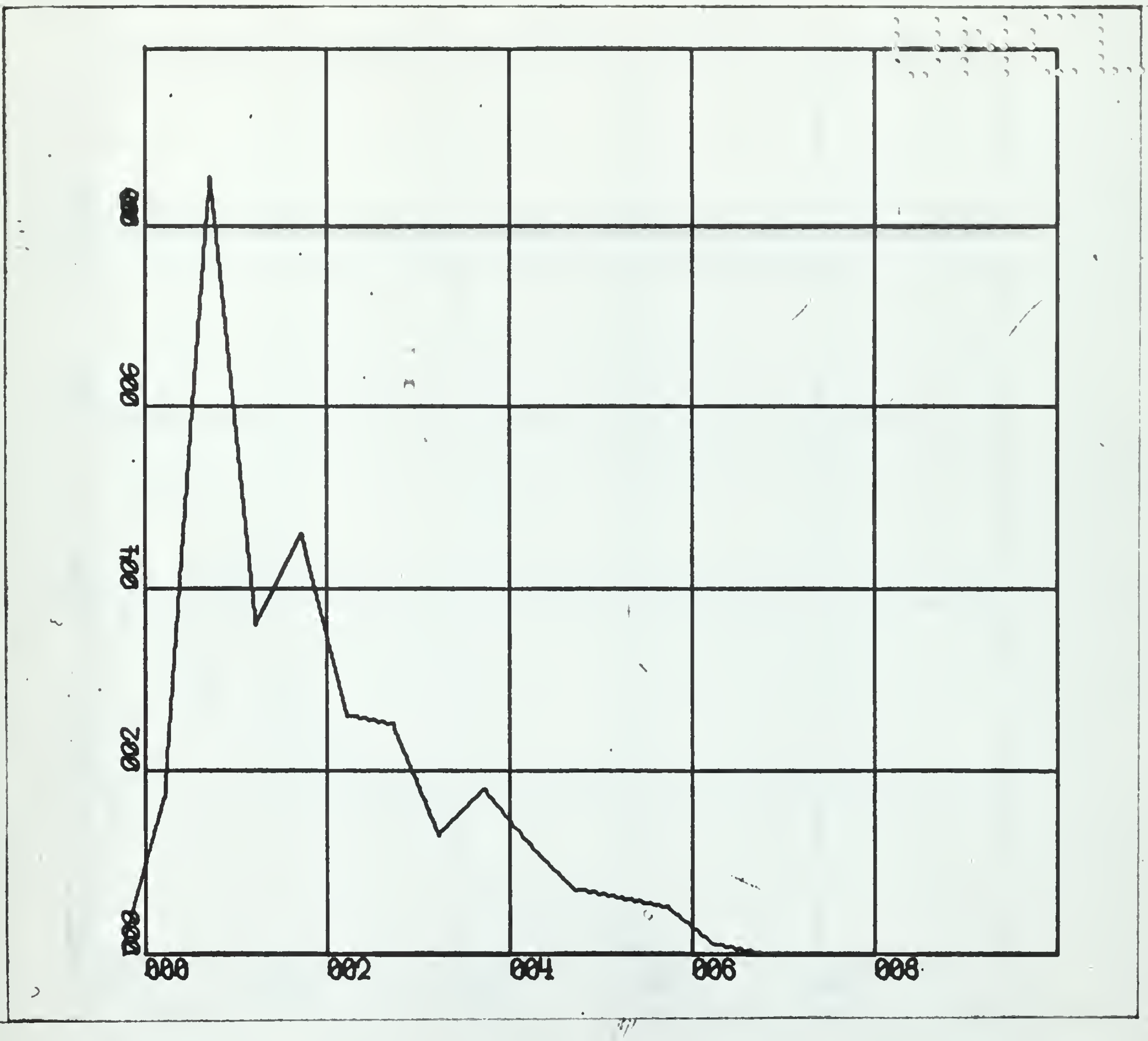
11. Total Pilot Time

The variable discussed in this section and those of the remaining sections have been studied for many years by NASC and are included in their annual report which displays the fleetwide picture of aircraft accident occurrence. They are of prime importance in depicting the proficiency and operational experience levels of pilots involved in accidents. However, these variables are members of a set of data which has been subjected to much analysis in the past. They have served a useful purpose in providing valuable information to initially reduce the Navy's aircraft accident rate. At the present, however, the easy and obvious remedies for accident causation have been taken, and these variables do not yield the subtle and hidden cause factors unless their values are extreme.

The frequency of total pilot time for pilots involved in CVA accidents during 1962 and 1963, Figs. 9a, 9b and 9c, shows a similar trend for each of the fleets. The curves rise sharply to the largest mode at 800 and 900 hours since most of the aviators flying from CVA's on their first tour of operational duty have accumulated approximately this amount of pilot time. In addition, these first tour pilots in general lack the experience and proficiency that comes with subsequent tours. The curves decrease after the first mode, resembling the pattern of rotation of these first sea tour pilots to their first shore duty which rarely involves carrier flying. Therefore a drop in accidents involving aviators with about 1500 pilot hours is to be expected. The SEVENTH FLEET differed slightly in that the decrease from the first mode covered a wider range of pilot hours. The second mode represents pilots on their second tour of carrier flying and occurred at slightly less than 2000 hours. The number of accidents represented by this mode is less than the first mode since aviators in this class are usually more experienced in carrier flying. The data as presented here represents only those aviators who had accidents, but it is suspected that a plot of total pilot hours for all CVA pilots would show modes at approximately the same locations.

Total pilot time was analyzed for 1962 and 1963 separately. The cumulative percentage distributions showed no significant difference in the two years at the .1 level when subjected to the K-S two sample test. Each of the fleet categories were also tested against the others at the .1 level and no difference was found to exist.

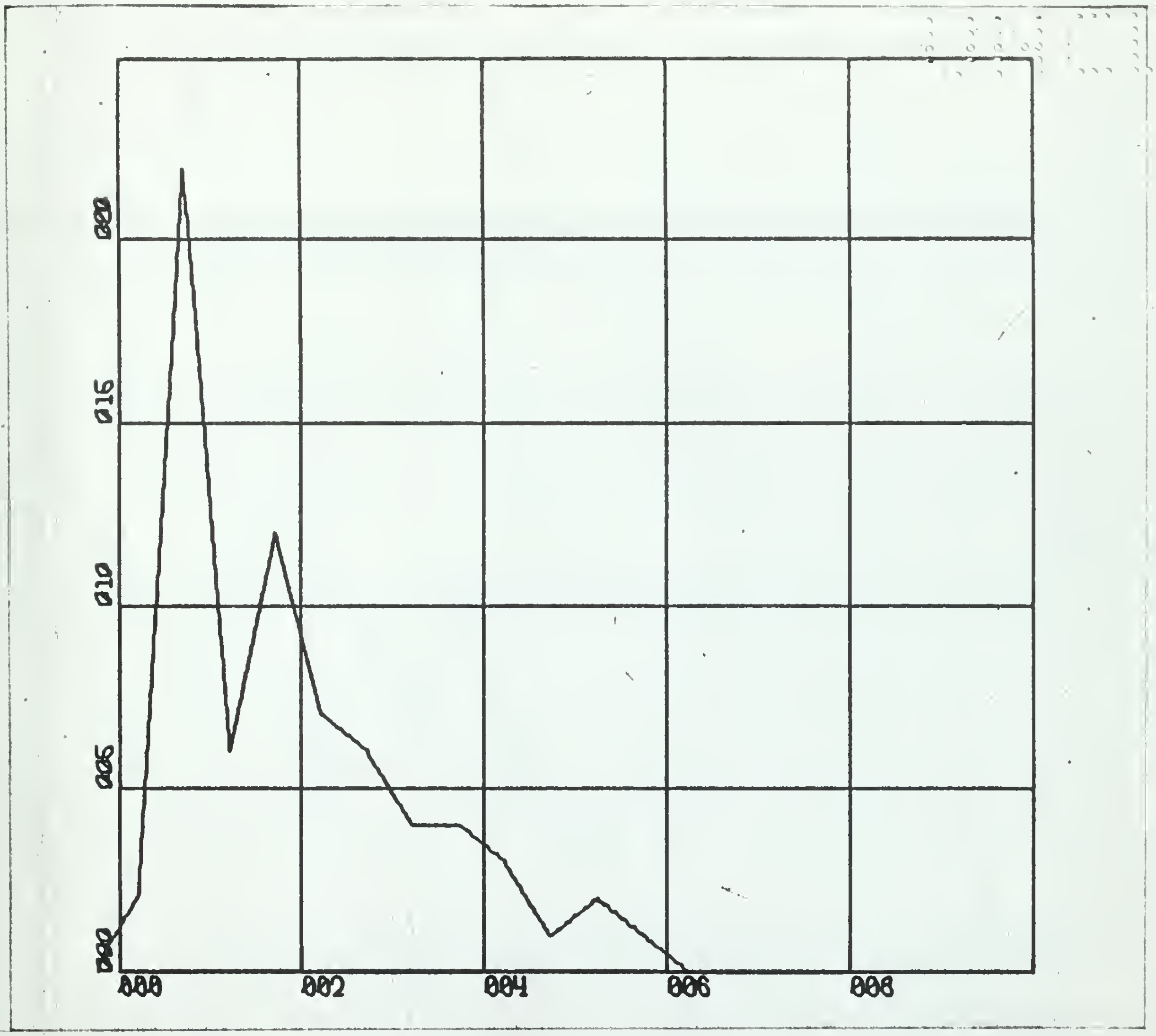
No data was obtained for pilots who were not involved in accidents. However, under the hypothesis that total pilot time for these aviators is not significantly different from the data shown in Figs. 9a, 9b and 9c, it can be concluded that total pilot time for aviators involved in accidents is a representative sample from the total population of aviators who fly from CVA's. Therefore, this variable does not appear to be useful in a discriminatory analysis where the objective is to determine functions of certain discriminating variables which will lead to prediction of accidents.



X-Scale=Hours x 1000

Y-Scale=Accidents x 10

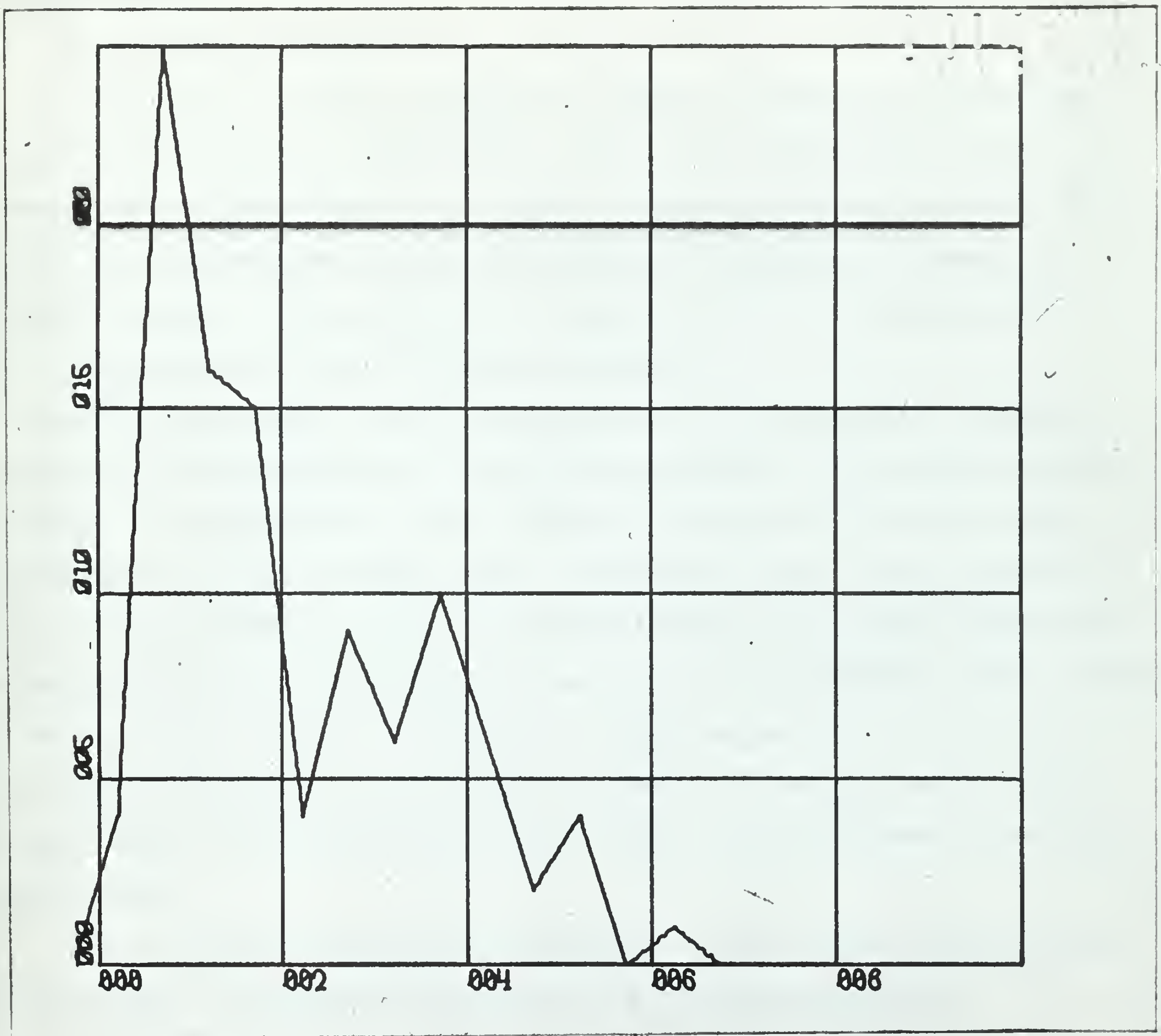
Fig. 9a. Total pilot time, Combined Fleets



X-Scale=Hours x 1000

Y-Scale=Accidents

Fig. 9b. Total pilot time, 6th FLEET



X=Scale=Hours x 1000
Y=Scale=Accidents

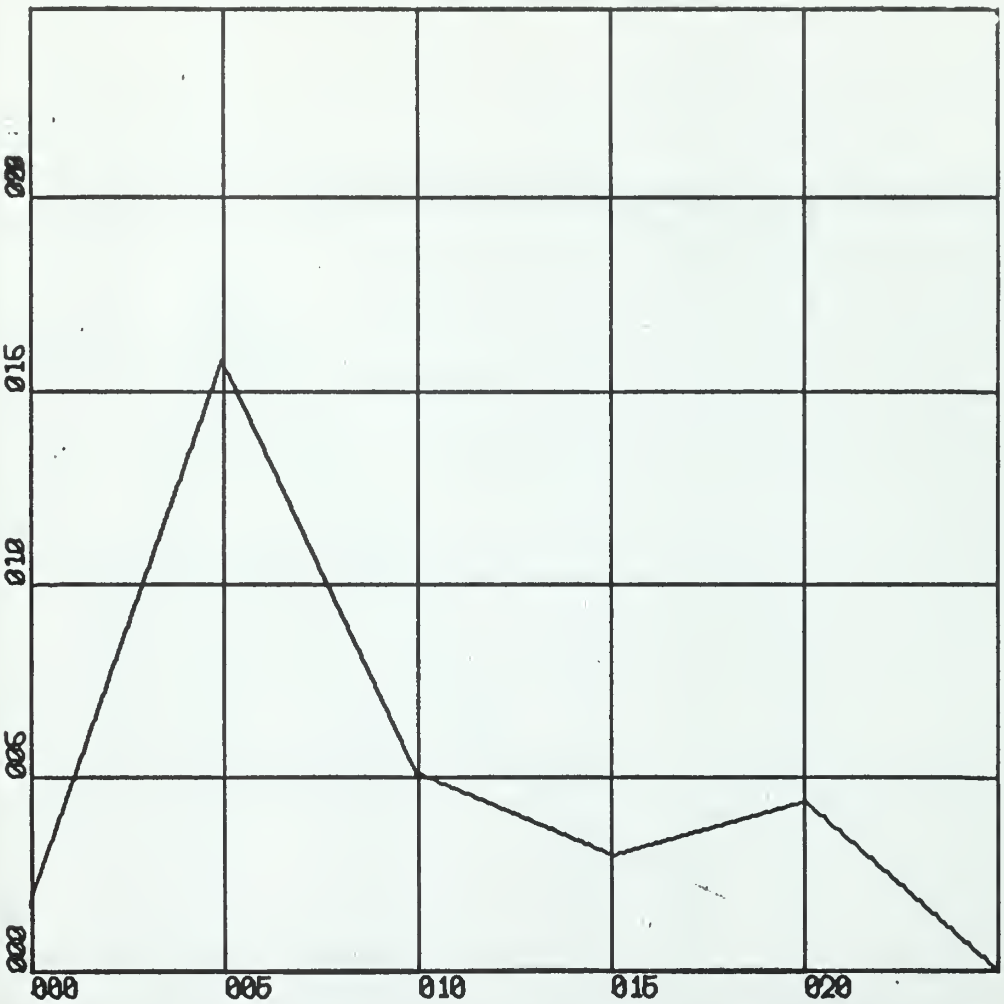
Fig. 9c. Total pilot time, 7th FLEET.

12. Years Military Flying.

The number of aircraft accidents is shown as a function of years military flying in Figs. 10a, 10b and 10c. This data as collected by the U. S. Naval Aviation Safety Center is recorded in integer increments through the ninth year. Otherwise it is coded in classes of 10 through 14 years, 15 through 20 years and over 20 years. Because of this data classification, some interpretations of the graphs is necessary.

As was pointed out for total pilot time, most of the accidents involved pilots with approximately five years flying experience. The number then decreased as these first tour pilots rotated to shore duty. This covers the period through about the tenth year. Other modes should appear between 10 and 15 years, however, both the combined fleets and the SIXTH FLEET show a continued decrease, although at a lesser rate. The SEVENTH FLEET showed a rise during this period. All fleets are characterized by a second mode at 20 years which should be interpreted as between 15 and 20 years. Integer classification of the data through all the years would have made these plots more precise.

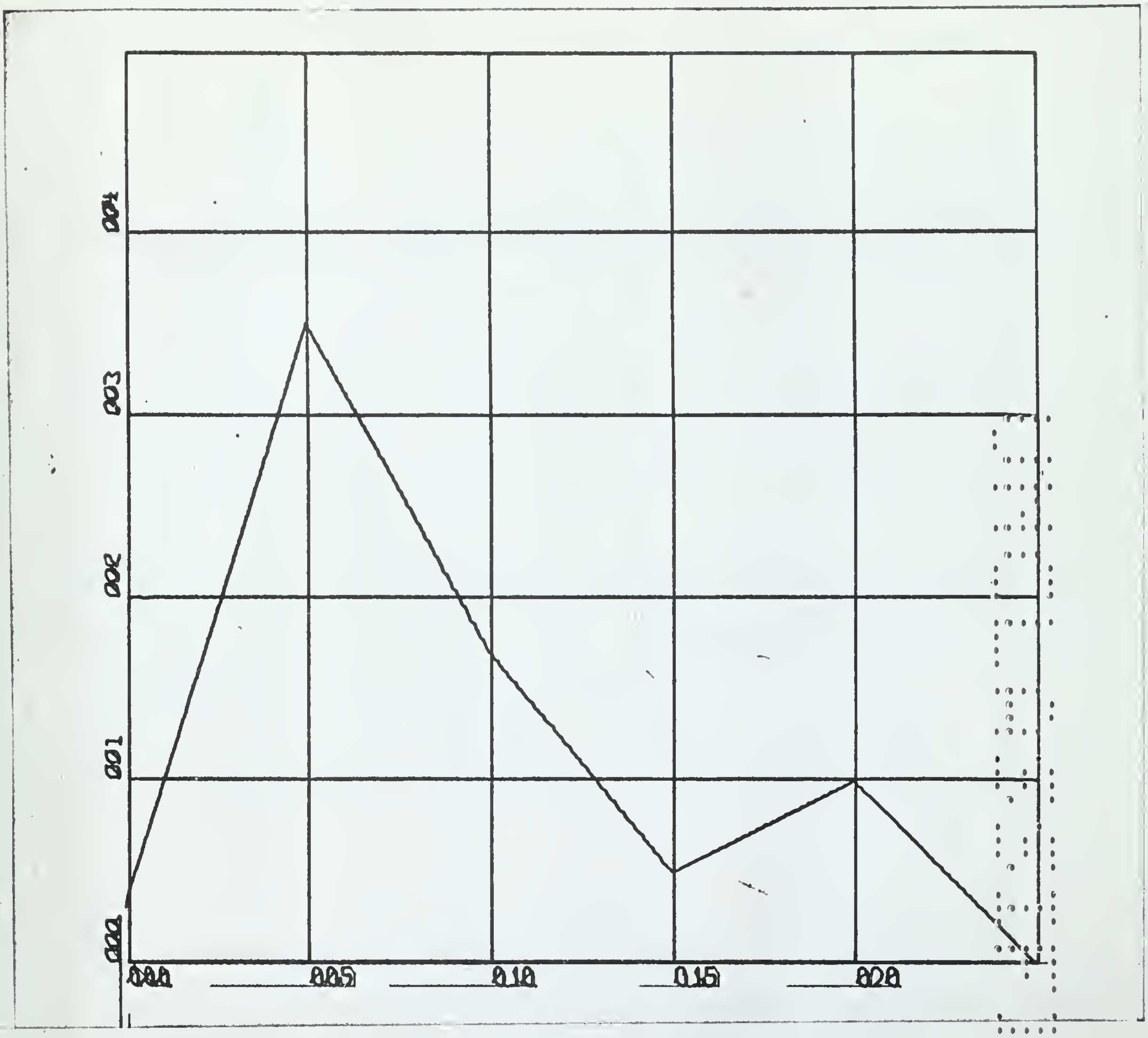
The cumulative percentage distributions for each of the fleets did not differ at the .1 significance level under the K-S two sample test.



X-Scale=Years

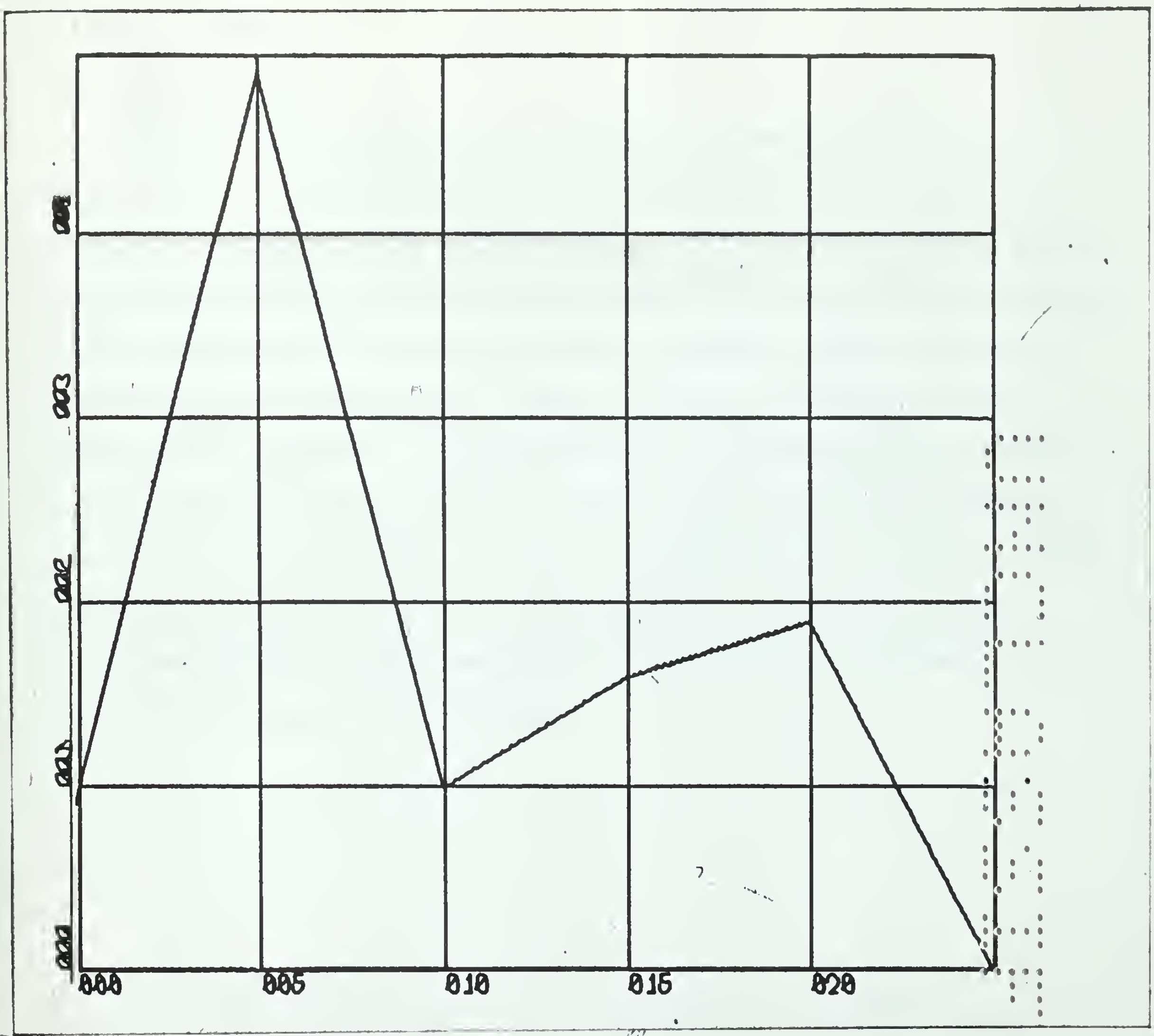
Y-Scale=Accidents x 10

Fig. 10a. Years military flying, Combined Fleets.



X-Scale=Years
Y-Scale=Accidents x 10

Fig. 10b. Years military flying, 6th FLEET.



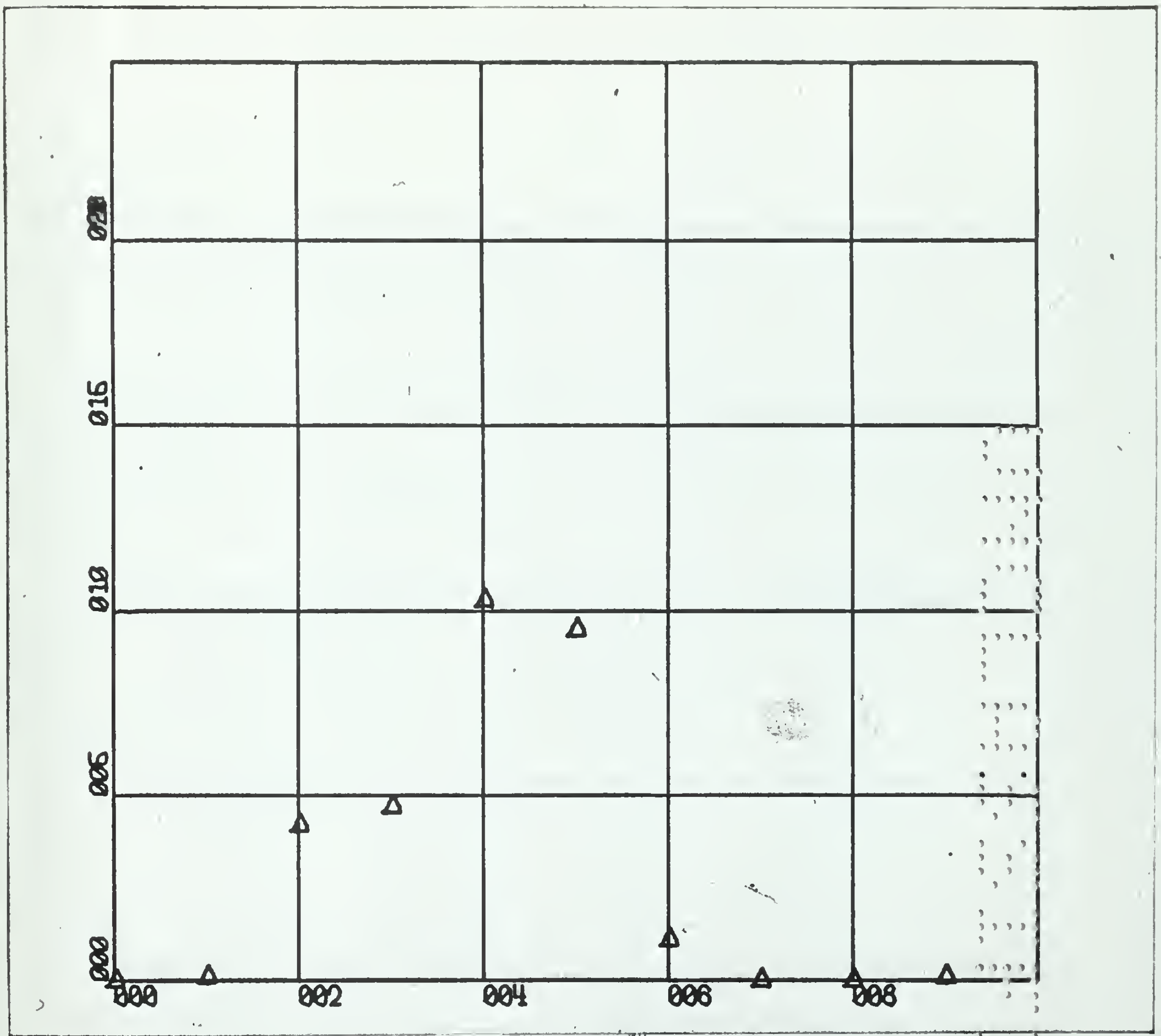
X-Scale=Years

Y-Scale=Accidents x 10

Fig. 10c. Years military flying, 7th FLEET.

13. Pilot's Rank.

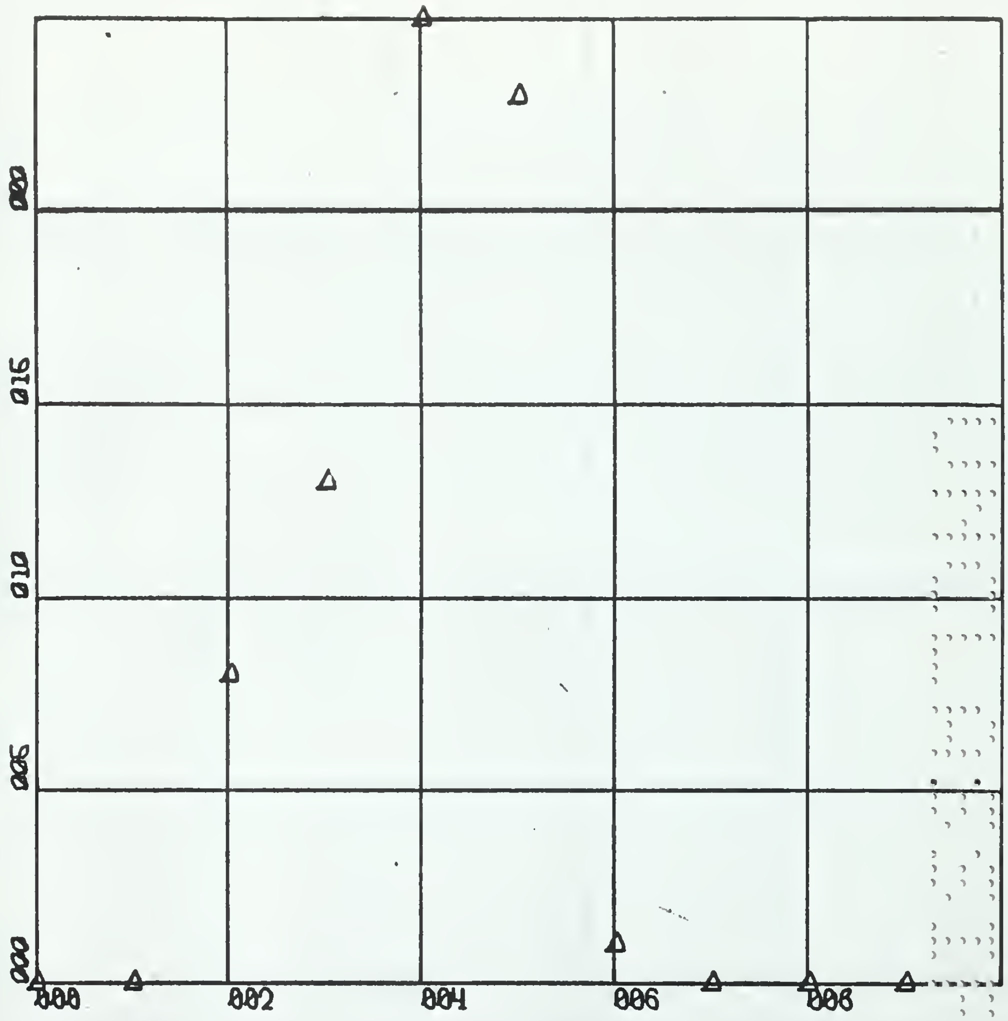
Analysis of the number of accidents as a function of the rank of the pilot follows the general pattern established by the plots of total pilot time and years military flying. Figs. 11a, 11b and 11c show that most of the accidents involved pilots of the ranks of LT and LTJG, which correspond to the modes at about 1000 pilot hours and one to five years flying experience. The rank groups of LCDR and CDR show fewer accidents, as did the curves for corresponding total pilot hours and years military flying. Again, the rank of pilots involved in accidents seems to follow the suspected distribution of pilots assigned to flying billets aboard CVA's. One exception appears in Fig. 11c, where the SEVENTH FLEET recorded more commanders involved in accidents than lieutenant commanders.



X-Scale: 1=CAPT
2=CDR
3=LCDR
4=LT
5=LTJG
6=ENS

Y-Scale=Accidents x 10

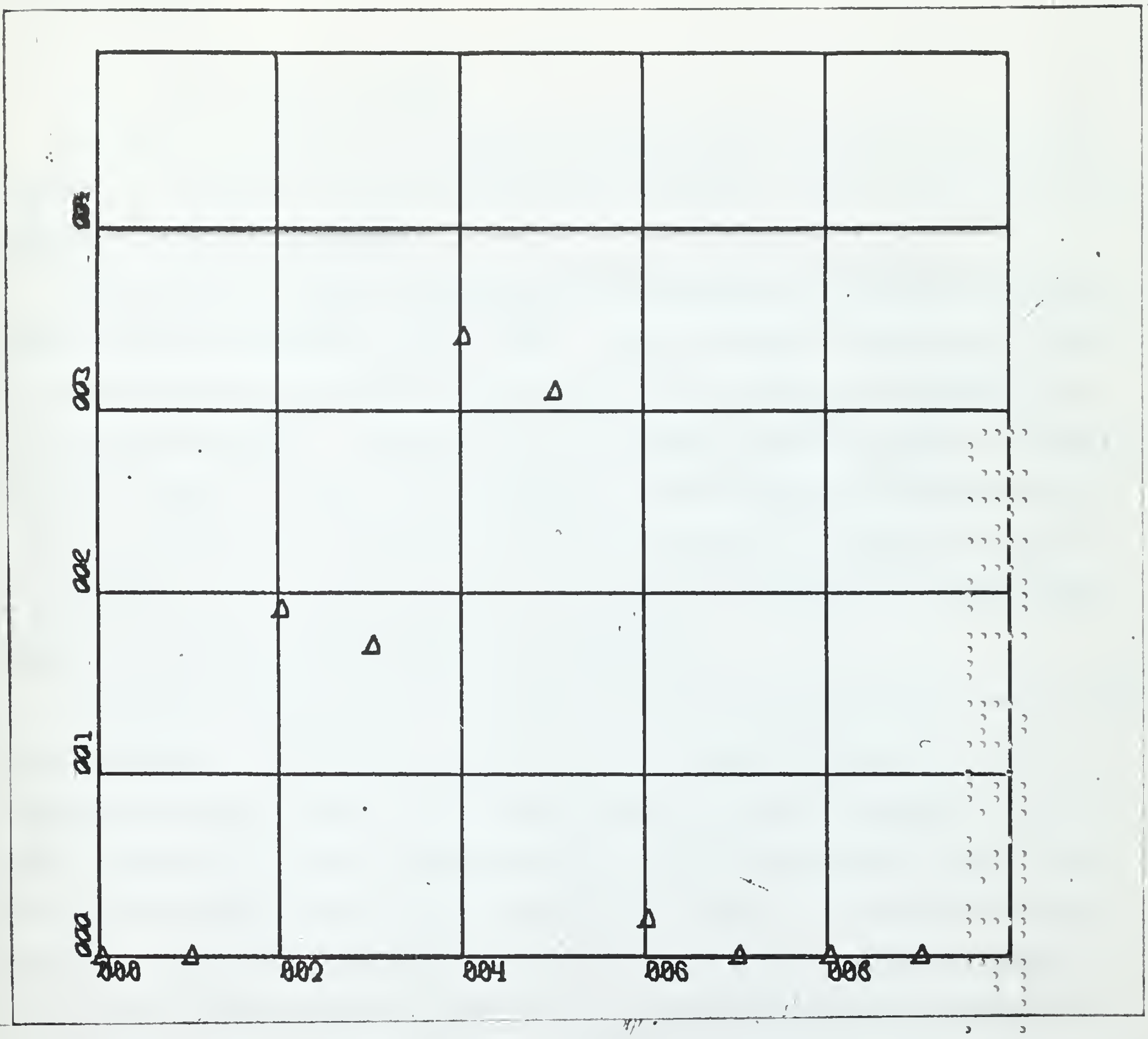
Fig. 11a. Pilot rank, Combined Fleets.



X-Scale: 1=CAPT
2=CDR
3=LCDR
4=LT
5=LTJG
6=ENS

Y-Scale=Accidents

Fig. 11b. Pilot rank, 6th FLEET.



X-Scale: 1=CAPT
2=CDR
3=LCDR
4=LT
5=LTJG
6=ENS

X-Scale=Accidents x 10

Fig. 11c. Pilot rank, 7th FLEET.

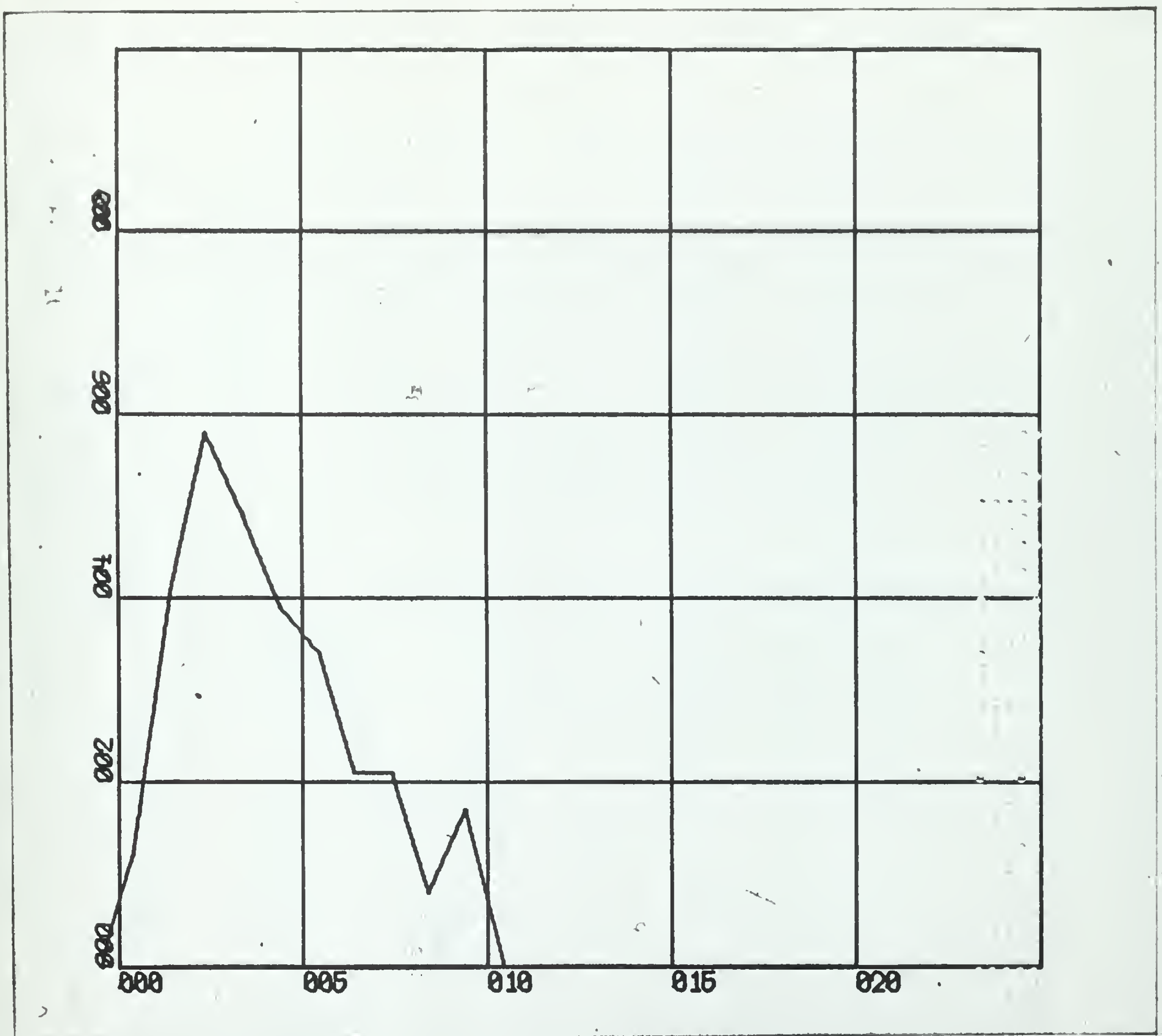
14. Pilot Time in Type Aircraft.

Number of accidents as a function of pilot hours in the particular type aircraft was studied for each of the fleet breakdowns. Figs. 12a, 12b and 12c represent the various fleets.

In all cases, a sharp rise occurred in the number of accidents involving pilots with less than 200 hours in type. Pilots normally commence a carrier tour with more than 50 hours in type since this is usually a requirement of the training squadrons. Therefore, the accidents shown for pilots with less than this amount of time can be attributed in most cases to incorrect data. In the few cases where pilot hours in type were either omitted in the data or indicated as less than ten hours, the computer programs for drawing the frequency curves interpreted this as zero hours.

A prominent mode existed at about 300 pilot hours in type for each of the fleet categories. Afterwards, the number of accidents decreased with increasing pilot time in type, this drop generally being more gradual than the initial rise and containing some secondary modes and periods of level off. Another mode appeared near 1000 pilot hours in type, and no accidents are shown for pilots with more than 1000 hours. It appears that pilots enter a danger zone as they approach 1000 hours in type and then are immune to accidents after passing this threshold. However, the explanation for this mode lies in the manner in which the data is coded. Two columns of the punch cards are used by NASC to code pilot hours in type, this data being expressed in tens of hours. A pilot having 267 hours in type is coded as 26. By this scheme, 990 hours is the maximum that can be coded. Of the 300 accidents involved in this study, there were ten accidents where the pilot time in type was coded as 99. Since this indicates 990 hours or more, it seems reasonable to expect not a mode, but a continuation of the decreasing curve in this area.

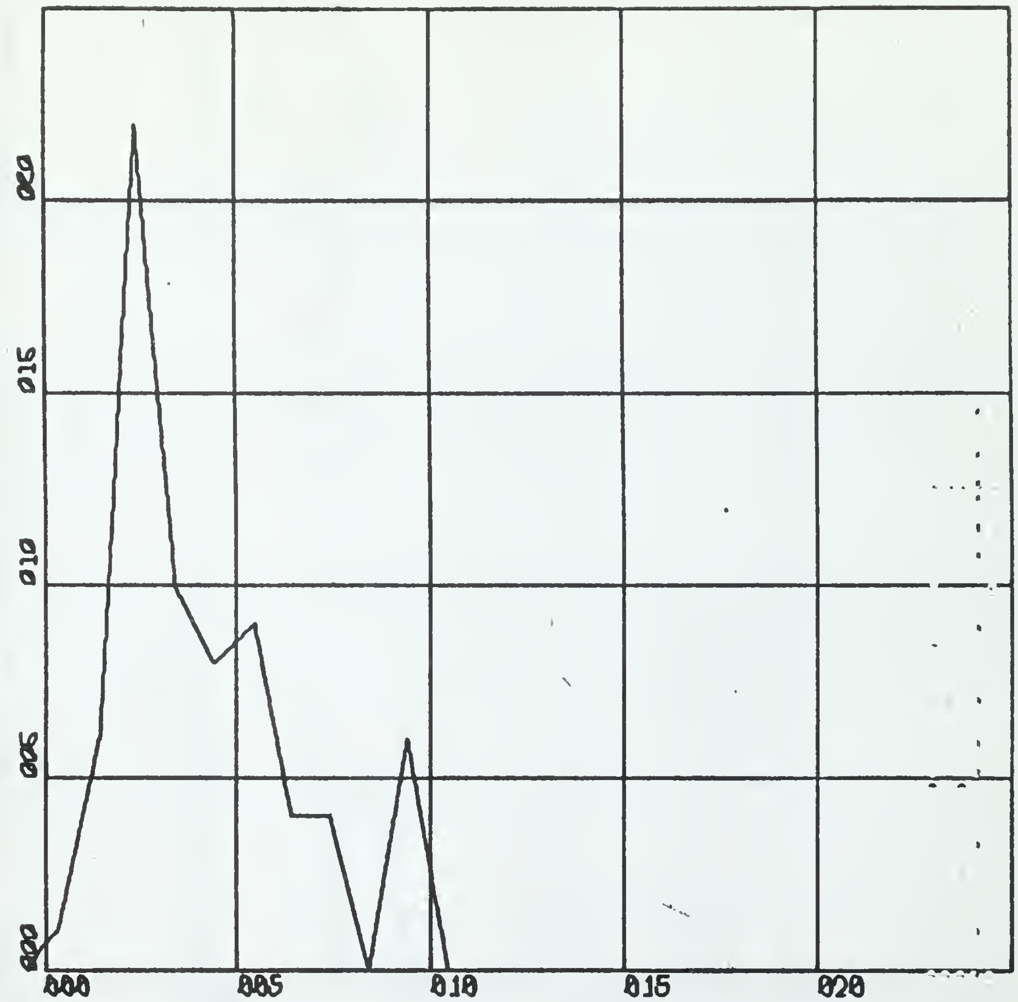
Figs. 12a, 12b and 12c represent only those pilots that were fying from the carriers. In order to detect areas of time in type aircraft where accident potential is significant, these plots must be compared with the distribution of pilot time in type for all the pilots aboard the CVA's. This data was not available for this study.



X-Scale=Hours x 100

Y-Scale=Accidents x 10

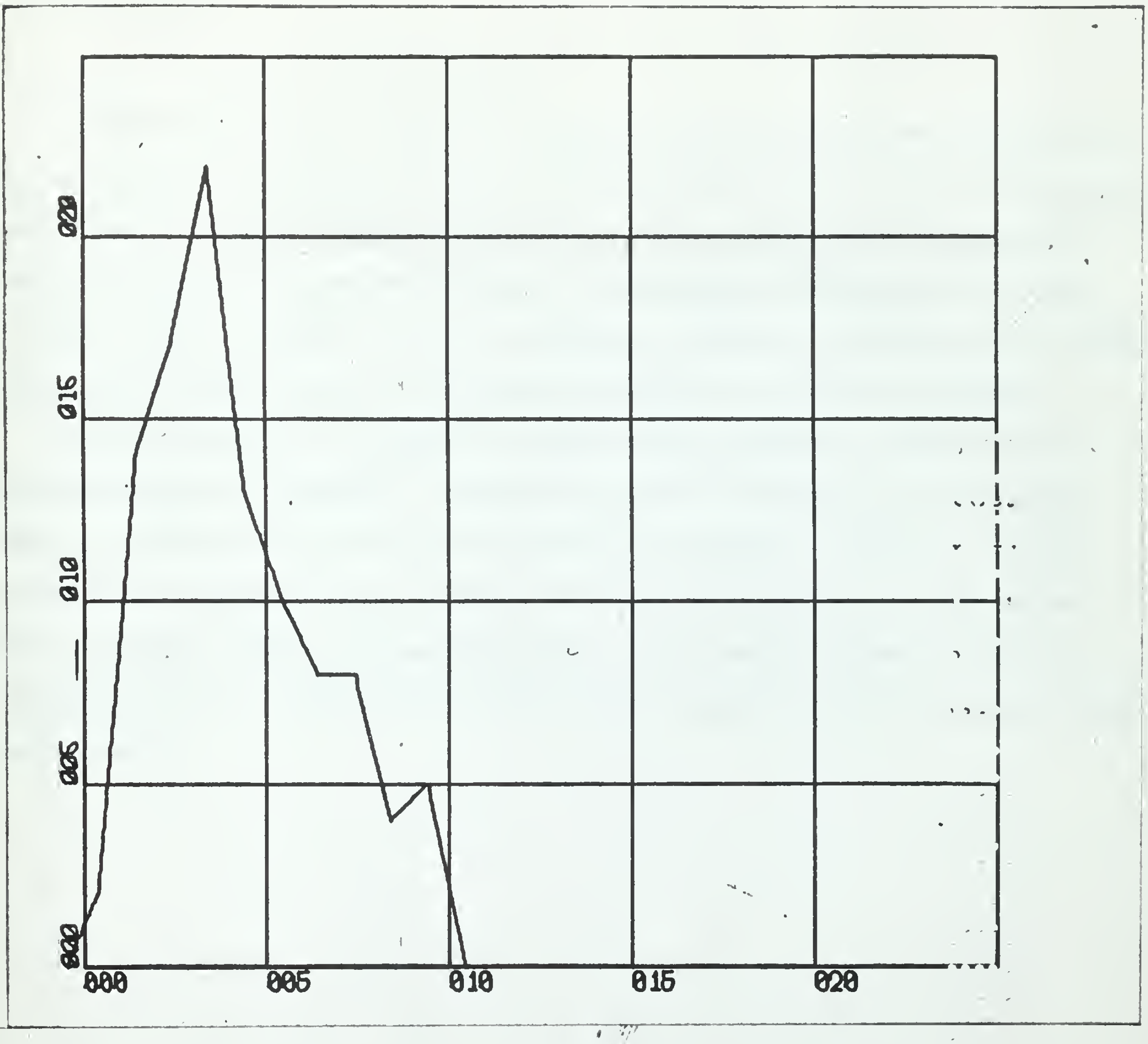
Fig. 12a. Time in type aircraft, Combined Fleets.



X-Scale=Hours x 100

Y-Scale=Accidents

Fig. 12b. Time in type aircraft, 6th FLEET.



X-Scale=Hours x 100

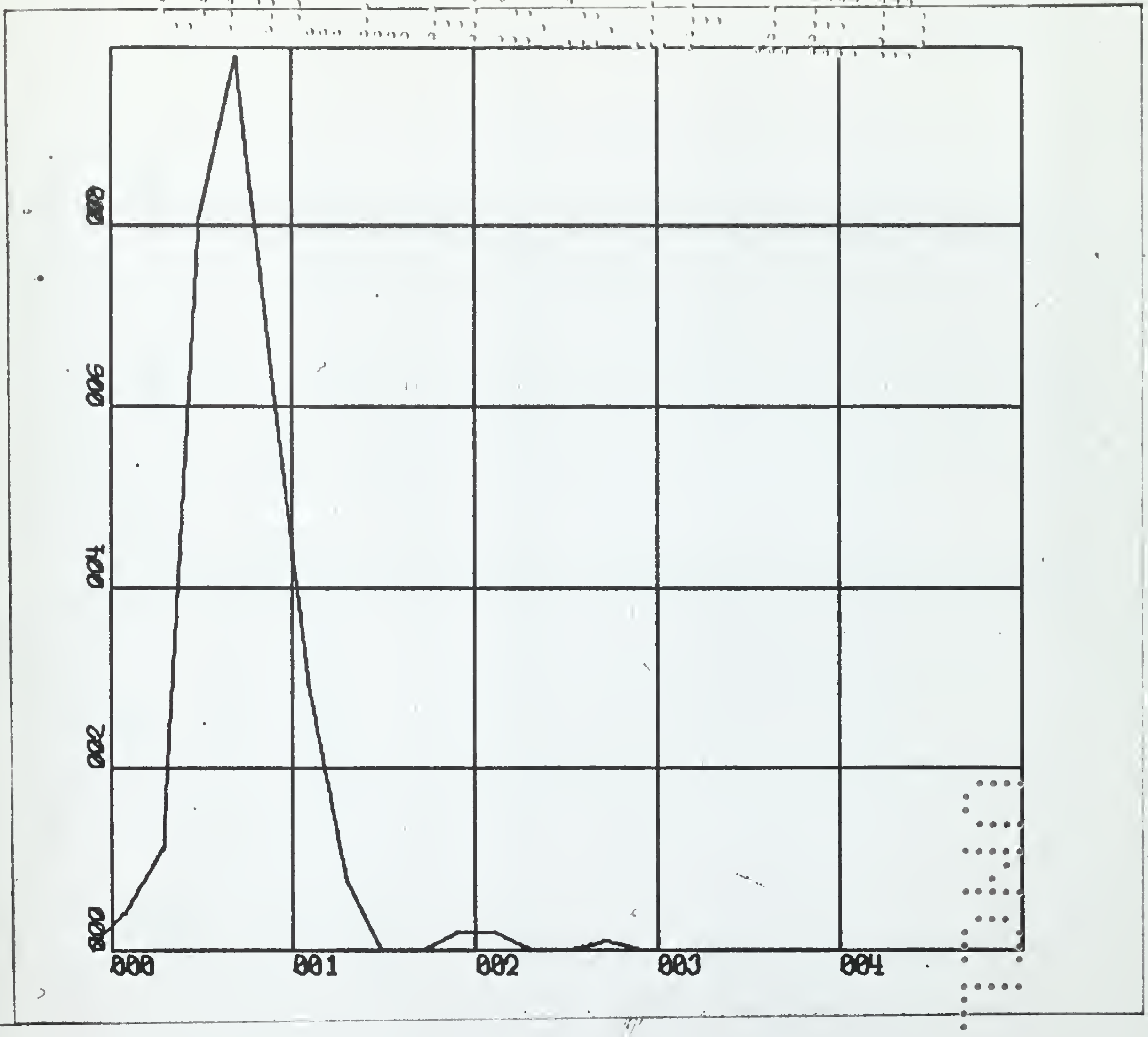
Y-Scale=Accidents

Fig. 12c. Time in type aircraft, 7th FLEET.

15. Pilot Time, Last Three Months.

Frequencies for the number of pilot hours during the three months prior to an accident are plotted in Figs. 13a, 13b and 13c. The curves are similar, each having a mode at 50-70 hours with a much smaller mode appearing at about 200 hours. Under the K-S test, no significant difference was found to exist at the .1 level. The data indicating more than 150 pilot hours in the three month period prior to an accident should be viewed with caution.

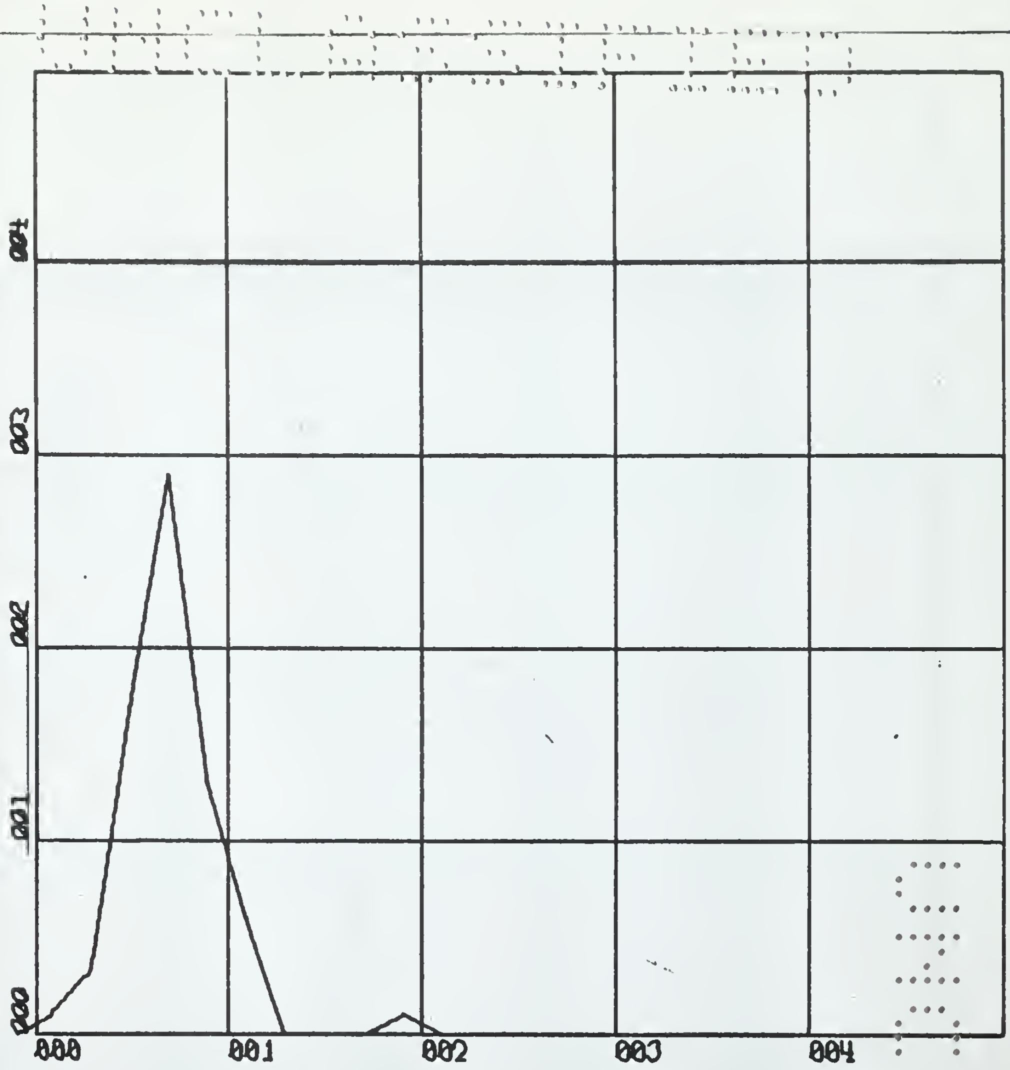
A pilot who flies 20 hours per month on the average, as did most of those involved in accidents, can be expected to remain at an acceptable level of proficiency under normal operating conditions. However, further study of the number of hours flown in the last 30 days and the last seven days may show areas of potential hazard. It is possible that too much or too little flying in a short time span such as a month or even less, can affect performance.



X-Scale=Hours x 100

Y-Scale=Accidents x 10

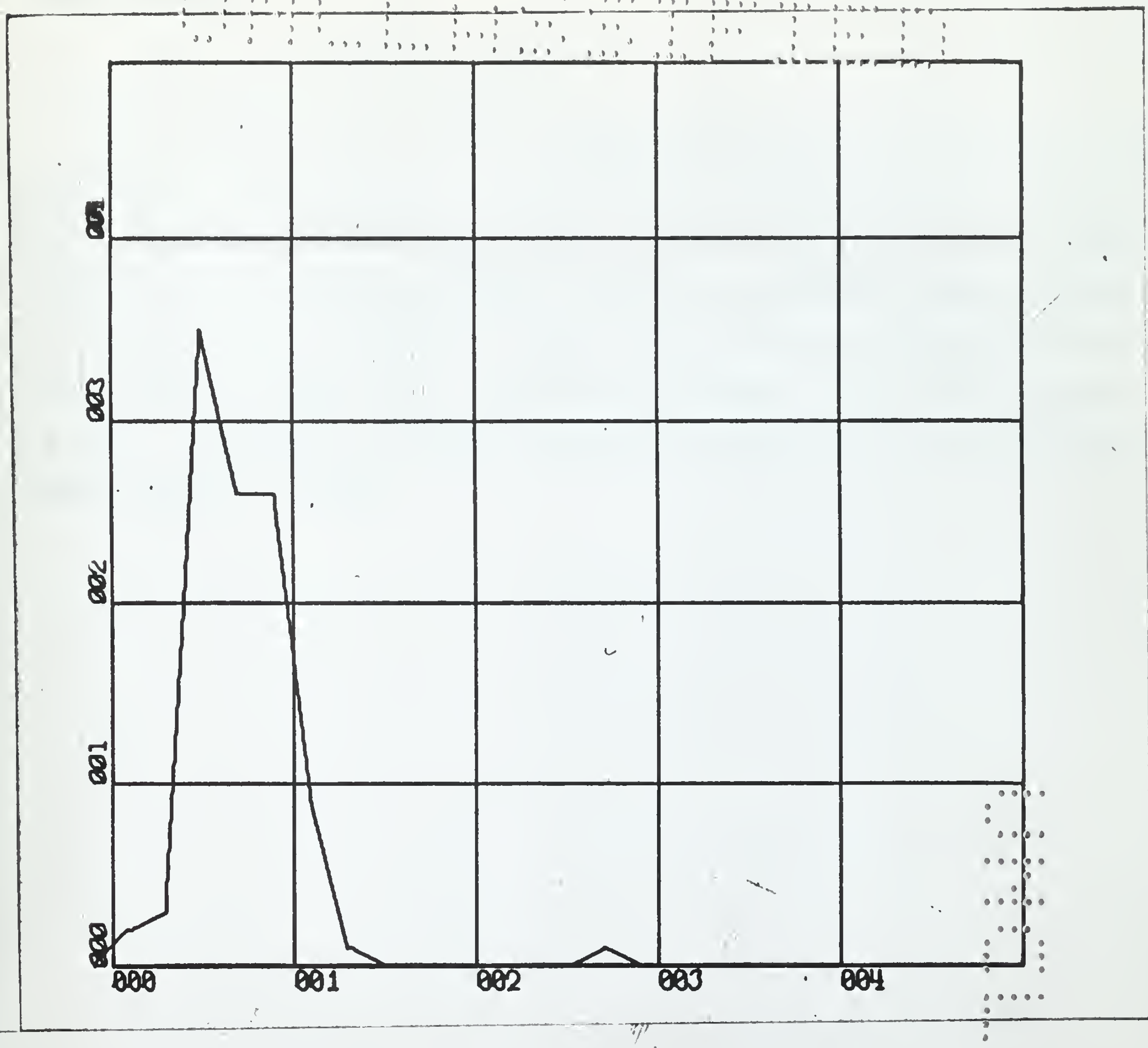
Fig. 13a. Pilot time last three months, Combined Fleets



X-Scale=Hours x 100

Y-Scale=Accidents x 10

Fig. 13b. Pilot time last three months, 6th FLEET.



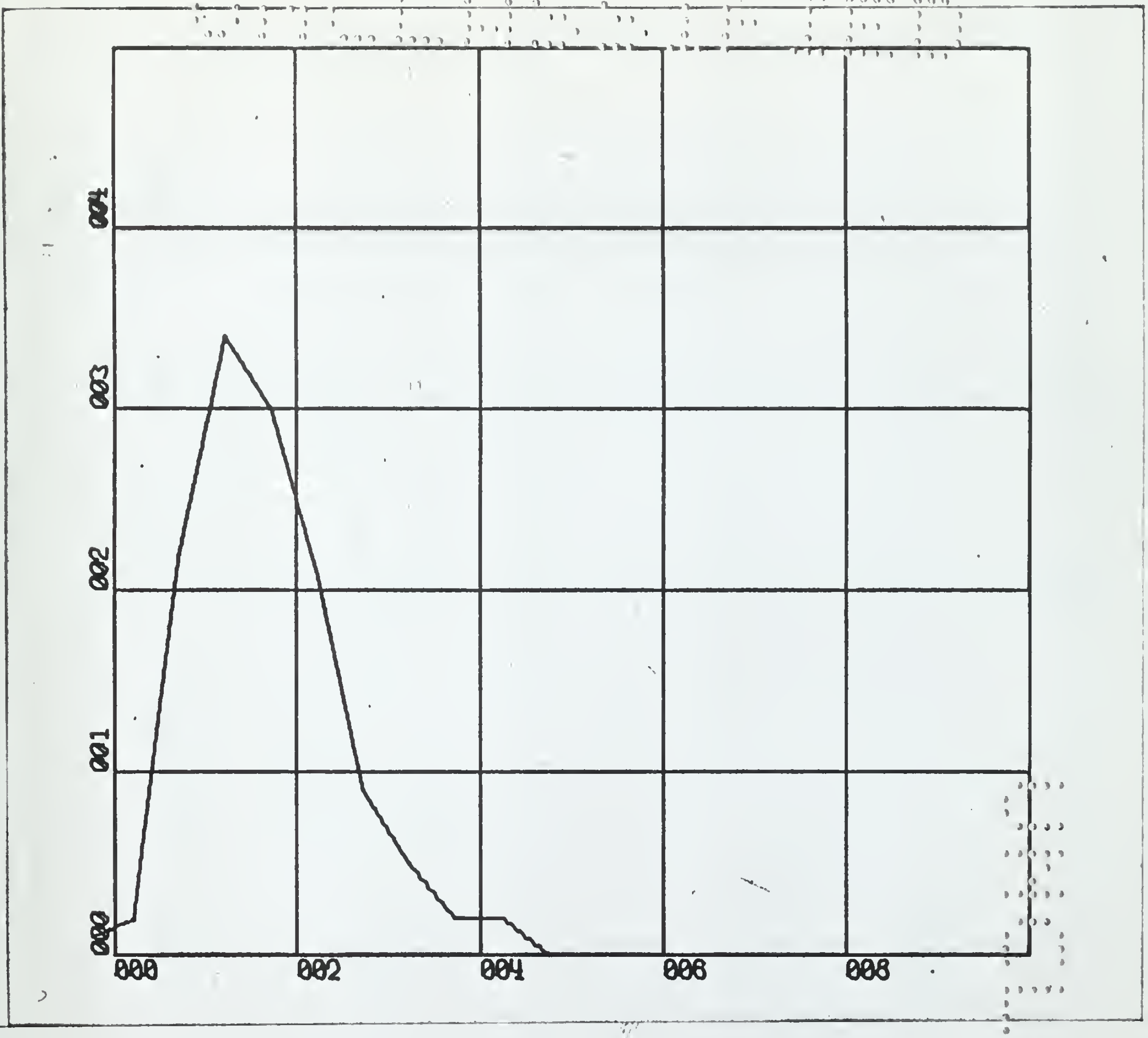
X-Scale=Hours x 100

Y-Scale=Accidents x 10

Fig. 13c. Pilot time last three months, 7th FLEET.

16. Night Time Last Three Months.

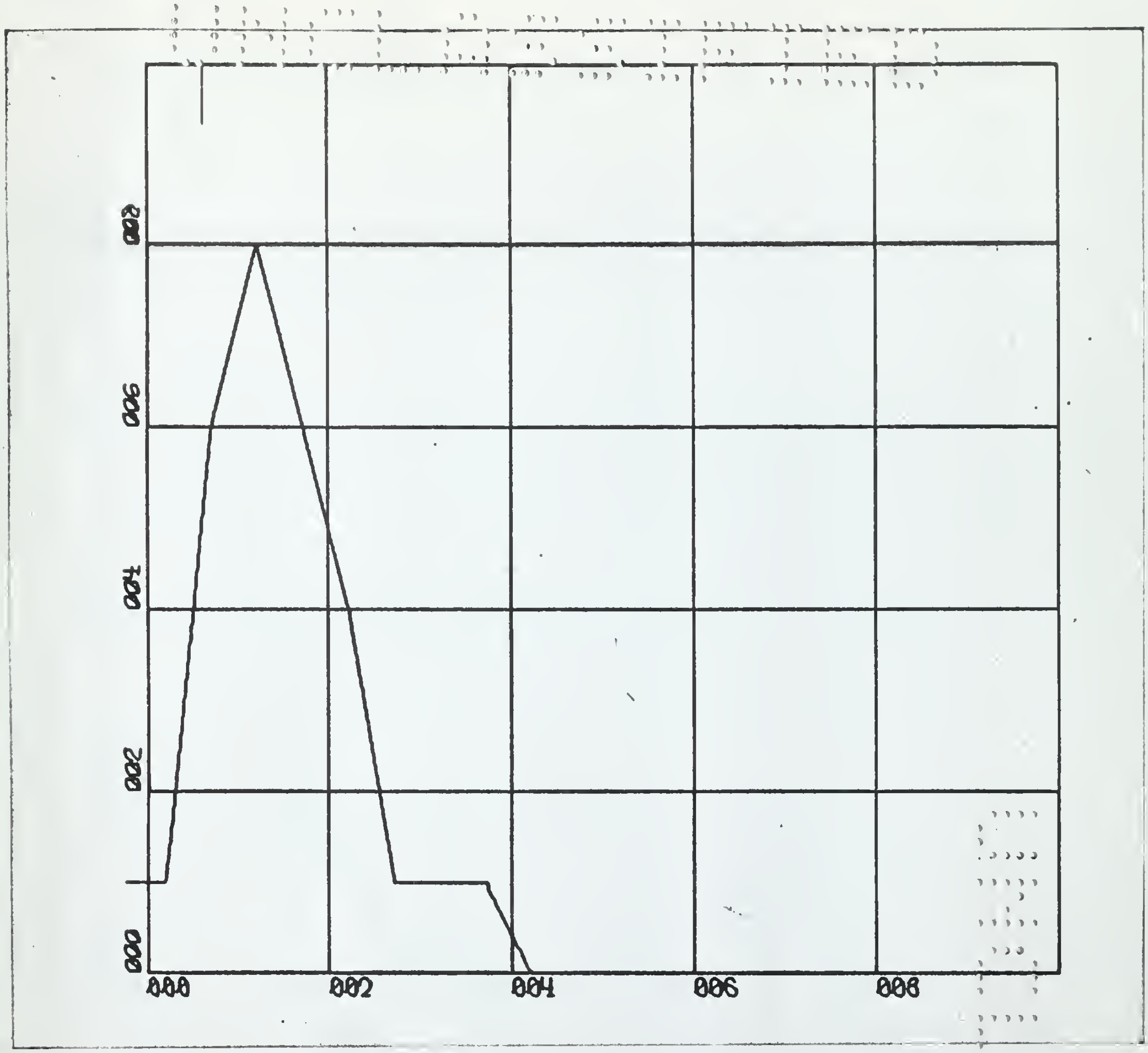
Figs. 14a, 14b, and 14c show the night pilot time in the last three months preceding a night accident. The total number of night accidents in the combined fleets for 1962 and 1963 was 128. Of these, 29 occurred in the SIXTH FLEET and 42 in the SEVENTH FLEET. Each of the deployed fleets suffered 41 percent of their accidents at night. Their cumulative percentage distributions did not differ at the .1 level of significance. Each had a mode at 15 hours. According to the plots, the average night time per month was between five and six hours.



X-Scale=Hours x 10

Y-Scale=Accidents x 10

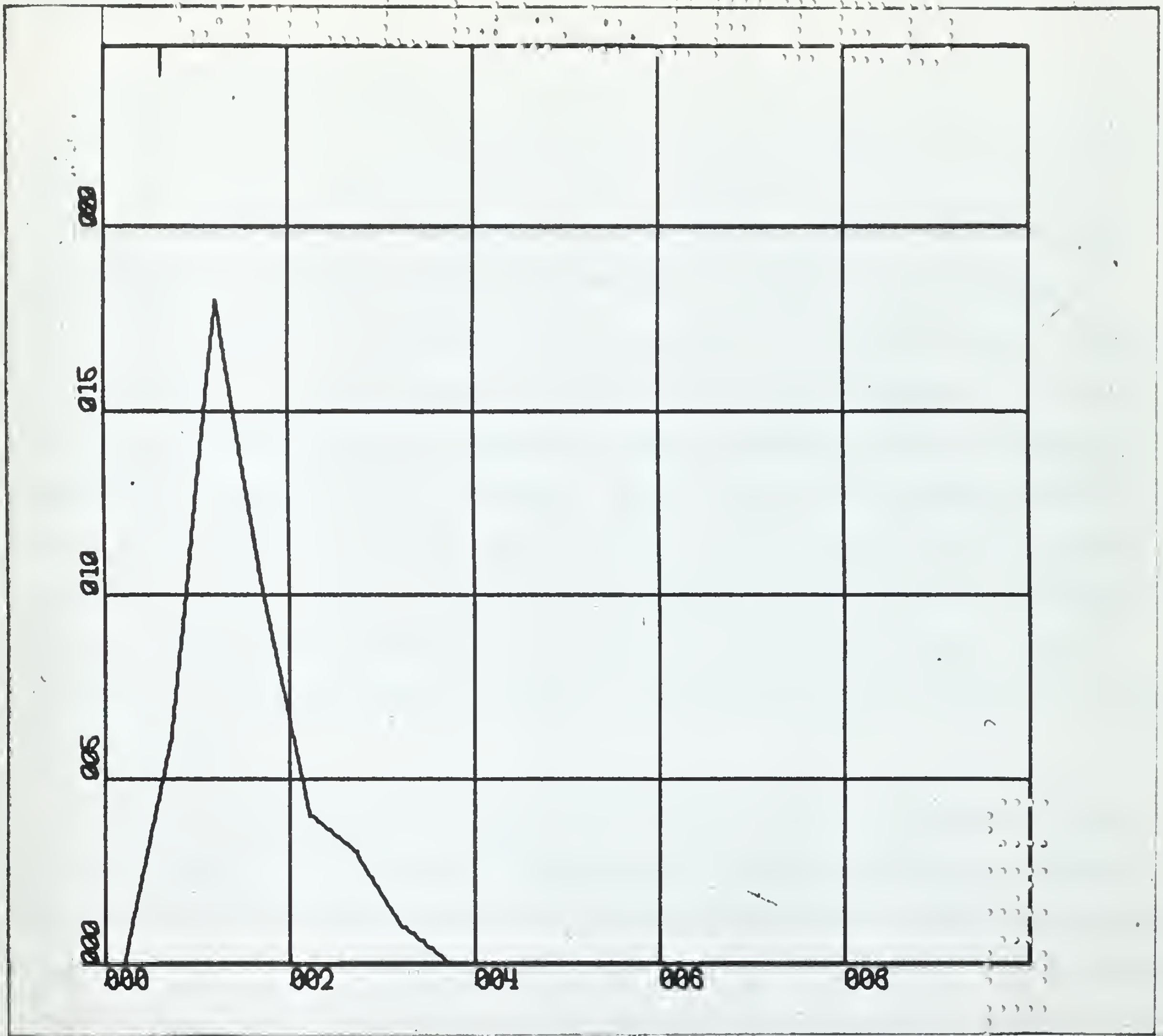
Fig. 14a. Night time last three months, Combined Fleets.



X-Scale=Hours x 10

Y-Scale=Accidents

Fig. 14b. Night time last three months, 6th FLEET.



X-Scale=Hours x 10

Y-Scale=Accidents

Fig. 14c. Night time last three months, 7th FLEET.

17. Areas for Further Study.

The assumption was made in Section 2 that whenever a CVA was reported to be at sea, flight operations were being conducted. This is generally true for most operating days. However, days of replenishment, restricted ship maneuvering and periods of crew rest while at sea make this assumption somewhat erroneous. In addition, all flying days are not the same. During fleet operations and exercises, the carriers sometimes operate on a continuous basis for several days, whereas a routine operating day may begin after sunrise and terminate before midnight. Some carriers limit night operations on the first night out of port in order to permit pilots to make one day landing before flying at night. A detailed examination of the type of operations that was being conducted when an accident occurred may provide useful information in understanding the causes and predicting the occurrence of aircraft accidents.

Certain variables such as the number of pilot hours, instrument hours and night hours are collected for the three month period prior to an accident. It is possible that these figures could indicate satisfactory performance over the entire period while the true status was very much different. The situation where a pilot flies 15 night hours at the beginning of this period and does not fly again at night until his accident, two months later, would not be detected with the present data. Similarly the total number of carrier landings, as presently collected, does not provide data concerning a period immediately prior to the accident. This information is usually contained in the body of the accident report, but is not coded on the punch cards. Analysis of operational performance for a short period immediately prior to an accident may reveal trends which could be useful in future accident prevention programs.

The rise in accidents toward the end of a deployment may be caused by many factors. Such areas as increased operating rate and commitments, over-confidence and fatigue are recommended for study. Another factor which may contribute to accident causation is the port of call. It is well known that some ports offer more recreation for the crew than do others. A study of the accidents which occur after the carrier leaves a particular port may reveal the effects of this factor.

The variables examined in this study pertained only to those pilots involved in accidents. A study of the same variables for pilots who did not have accidents is recommended. In addition, an analysis of variance may produce interesting results in establishing the effects of some of the variables.

The data presently collected which describes aircraft accidents has been valuable in reducing the occurrence of accidents. However, it is not sufficient to thoroughly analyze the underlying causes which do not appear in studies such as this. The use of an experimental design model is recommended to aid in the determination of meaningful variables which will further the progress of accident prediction and prevention.

BIBLIOGRAPHY

1. Lindgren, B. W. Statistical Theory. The MacMillan Co., 1962.

2. Lloyd, D. K. and Lipow, M. Reliability: Management, Methods and Mathematics. Prentice-Hall, Inc., 1962.

3. Tate, M. W. and Clelland, R. C. Non Parametric and Shortcut Statistics. Interstate Printers and Publishers, Inc., 1959.

APPENDIX I

OPNAV ZULU DATA

Operating data for the units based aboard CVA class carriers was supplied for this study by NAVCOSSACT in the form OPNAV ZULU Reports recorded on high density tapes. This data consists of operational and maintenance information for every aviation unit presently in commission in the Navy, and is compiled in 558 character records, each record covering the performance of the unit for a one-month period. The format of the record lists the BNEP (Basic Naval Establishment Plan) Code, Command Code and Unit Code as identifiers of the units submitting the reports. Since there are many aviation units which have the same BNEP and Command Codes, the Unit Code must be used to select particular squadrons, such as those which served aboard CVA's. Once the Unit Code is known, the location of a squadron can be obtained by a cross check of the Master Locator File for the particular month desired. However, the Unit Code undergoes monthly change, and in order to utilize the information contained in the OPNAV ZULU Reports over an extended period of time, it is necessary to locate each desired Unit Code on the Master Locator File for each month. These Unit Codes must then be matched, by month, against the OPNAV ZULU Reports so that the proper units may be selected. Although the Master Locator Files were available for the 24 months covered by this study, time was not available to complete this process.

Since much of the data contained in the OPNAV ZULU Reports is related to maintenance and readiness of aircraft, only those portions pertaining to actual operating performance were desired for this study. An object program was written by Lois Brunner of the USNPGS Computer Facility which will screen and edit the high density OPNAV ZULU Tapes. Output is low density 88 character records consisting only of operational data for 1962 and 1963 for those squadrons whose BNEP Code indicate CVA operations. The output format and program listing are included at the end of this appendix.

REVISED OPNAV ZULU FORMAT

Card Columns	
1	Type
2-3	BNEP Code
4-5	Command Code
6-10	Model Plan Code
11-15	Unit Code
16-23	Model Description
24-25	Month
26	Year
27-31	Total Flying Hours
32-36	Total Flights
37-41	Carrier Arrested Landings (Day)
42-46	Carrier Arrested Landings (Night)
47-51	Bolter (Day)
52-56	Bolter (Night)
57	Flight Purpose Code
58-61	Flights
62-66	Hours
67	Flight Purpose Code
68-71	Flights
72-76	Hours

THIS IS A LISTING OF THE IBM 1401 OBJECT PROGRAM DESIGNED TO SCREEN AND EDIT HIGH DENSITY OPNAV ZULU TAPES. OUTPUT IS LOW DENSITY 88 CHARACTER RECORDS CONSISTING OF OPERATIONAL DATA FOR 1962 AND 1963 FOR THOSE UNITS WHOSE BNEP CODES INDICATE CVA OPERATIONS.

```
,008015,022026,030037N000,044,049053,069072N0C001026
L068116,105106,110117B101/I9I=071029C029074B026/B001/0991,001/001117I0+099
,008015,022029,056063/056029                                            ,0240671056
                CTL66                                                   N001056I056        R
01010           ORG0401                                                 NCC1056I056        2PNTS1
0102001INPUT    DCW*                                                    L0244011056        FPNTS1
0102102BNEP     DC  *                                                   M0254031056        5PNTS1
0102329         DC  *                                                   M0524321056        5PNTS1
0103004AREA1    DC  *                                                   M0274361056        5PNTS1
0104032         DC  *                                                   M0554681056        5PNTS1
0105032         DC  *                                                   M0555001056        5PNTS1
0106032         DC  *                                                   M0555321056        5PNTS1
0107032         DC  *                                                   M0555641056        5PNTS1
0108004         DC  *                                                   M0275681056        5PNTS1
0109010AREA2    DCW*                                                    L0335781056        FPNTS1
0110010         DC  *                                                   M0335881056        5PNTS1
0111010AREA3    DCW*                                                    L0335981056        FPNTS1
0112010         DC  *                                                   M0336081056        5PNTS1
0113020AREA4    DCW*                                                    L0436281056        FPNTS1
01210   *   AREA1=INPUT RECORD COLS. 1-36                               N0010561056         PNTS1
01220   *   AREA2=INPUT RECORD COLS. 169-178                            N0010561056         PNTS1
01230   *   AREA3=INPUT RECORD COLS. 189-198                            N0010561056         PNTS1
01240   *   AREA4=INPUT RECORD COLS. 209-228                            N0010561056         PNTS1
01250   *   INPUT RECORD 558 CHARACTERS                                 N0010561056         PNTS1
01260   *   OUTPUT RECORD 76 DATA + 12 BLANKS = 88 CHAR.                NC010561056         PNTS1
02010           ORG1000                                                 N0010561056        2PNTS1
0202008TREAD    MU (U2          INPUT        RREAD INPUT TAPE  L074‡071056M(U2401R  PNTS1
0203004         SBRTEMP                                        L070‡111056HV01      PNTS1
0204005         B   TRERR                    L                 L071‡161056B/53L     PNTS1
0205005         B   TREOR                    KEND-OF-REEL TESTL071‡211056BS10K     PNTS1
0206007         C   NB482       TEMP                           L073‡281056CV04V01   PNTS1
0207005         B   TESTO                    U                 L071‡331056B‡38U     PNTS1
0209004         B   TREAD                                      L070‡371056B‡00      PNTS1
0211008TESTO    B   TEST1       0426         2TEST 1962        L074‡451056B‡584262  PNTS1
0212008         B   TEST1       0426         3TEST 1963        L074‡531056B‡584263  PNTS1
0213004         B   TREAD                                      L070‡571056B‡00      PNTS1
0214007TEST1    MCWNB2          X1                             L073‡641056MU64089   PNTS1
0215007TEST1AC      BNEP        CODES       1                  L073‡711056C403UW8   PNTS1
0216005         B   TFORM                    S                 L071‡761056B‡96S     PNTS1
0217008         B   TREAD       X1     -001 3                  L074‡841056B‡000883  PNTS1
0218007         A   NB2         X1                             L073‡911056AU64089   PNTS1
```

```
0219004      B  TEST1A                                     L070+951056B+65      PNTS1
0220007TFORM MCWBLANK      0188                            L073/021056MV16188   PNTS1
0221007      MCWAREA4      0176                            L073/091056M628176   PNTS1
0222007      MCWAREA3      0156                            L073/161056M598156   PNTS1
0223007      MCWAREA2      0146                            L073/231056M578146   PNTS1
0224007      MCWAREA1      0136                            L073/301056M436136   PNTS1
0225008TWRITEMU (U4        0101          WWRITE OUTPUT     L074/381056M(U4101W  PNTS1
0226005      B  TWERR                    L                 L071/431056BS91L     PNTS1
0227005      B  TWEOR                    K                 L071/481056BU30K     PNTS1
0228004      B  TREAD                                      L070/521056B+00      PNTS1
1001004TRERR SBRTRERRT+003                TAPREAD ERR RTN  L070/561056HS09      PNTS1
1002007      MN ZERO3      ERCNTR                          L073/631056DU67V18   PNTS1
1003005CRERR CU (U2                      BBACKSPACE TAPE 2L071/681056U(U2B     PNTS1
1004008      MU (U2        INPUT         RREREAD TAPE      L074/761056M(U2401R  PNTS1
1005004      SBRTEMP                                       L070/801056HV01      PNTS1
1006005      B  TREOR                    K                 L071/851056BS10K     PNTS1
1007007      A  NB1        ERCNTR                          L073/921056AV19V18   PNTS1
1008008      B  TRERRT     ERCNTR        9TRY 10 TIMES     L074S001056BS06V189  PNTS1
1009005      B  CRERR                    L                 L071S051056B/64L     PNTS1
1010004TRERRTB  0000                                       L070S091056B000      PNTS1
1101005TREOR CU (U2                      UTAPREAD E-O-R    L071S141056U(U2U     PNTS1
1102007      MCWEOR2M1     0240                            L073S211056MY18240   PNTS1
1103001      W                                             L067S2210562         PNTS1
1104007      MCWEOR2M2     0240                            L073S291056MY50240   PNTS1
1105001      W                                             L067S3010562         PNTS1
1106007      MCWEOR2M3     0240                            L073S371056MY82240   PNTS1
1107001      W                                             L067S3810562         PNTS1
1108007      MCWEOR2M4     0240                            L073S451056MZ14240   PNTS1
1109001      W                                             L067S4610562         PNTS1
1110007      MCWEOR2M5     0240                            L073S531056MZ46240   PNTS1
1111001      W                                             L067S5410562         PNTS1
1112007      MCWEOR2M6     0240                            L073S611056MZ78240   PNTS1
1113002      CC                          A                 L068S631056FA        PNTS1
1114001      W                                             L067S6410562         PNTS1
1115001      CS                                            L067S651056/         PNTS1
1116001      CS                                            L067S661056/         PNTS1
1117001      H                                             L067S671056.         PNTS1
1118005      B  WTM4                     D                 L071S721056BS77D     PNTS1
1119004      B  TREAD                     CONT. NEXT REEL  L070S761056B+00      PNTS1
1120005WTM4  CU (U4                      MTAPE MARK ON 4   L071S811056U(U4M     PNTS1
1121005      CU (U4                      UREWIND-UNPOAD 4  L071S861056U(U4U     PNTS1
1122004      H  *       -003              END-OF-JOB       L070S901056.S87      PNTS1
1201004TWERR SBRTWERRT+003                TAPWRT ERR RTN   L070S941056HT35      PNTS1
1201507      MN ZERO3      SKPCNT                          L073T011056DU67V17   PNTS1
1202007      MN ZERO3      ERCNTR                          L073T081056DU67V18   PNTS1
1203005CWERR CU (U4                      BBACKSPACE TAPE 4L071T131056U(U4B     PNTS1
1204008MWERR MU (U4        0101          W                 L074T211056M(U4101W  PNTS1
1205005      B  TWERR1                   L                 L071T261056BT36L     PNTS1
1206005      B  TWEOR                    K                 L071T311056BU30K     PNTS1
```

```
1207004TWERRTB  0000                                       L070T351056B000      PNTS1
1208007TWERR1A  NB1            ERCNTR                      L073T421056AV19V18   PNTS1
1209008       B  TWERR2        ERCNTR    9TRY 10 TIMES     L074T501056BT55V189  PNTS1
1210004       B  CWERR                                     L070T541056BT09      PNTS1
1211007TWERR2A  NB1            SKPCNT                      L073T611056AV19V17   PNTS1
1211507       MN ZERO3         ERCNTR                      L073T681056DU67V18   PNTS1
1212005       CU (U4                     ESKIP TAPE        L071T731056U(U4E     PNTS1
1213008       B  BADTAP        SKPCVT    4TRY 3X10 TIMES   L074T811056BT86V174  PNTS1
1214004       B  MWERR                                     L070T851056BT14      PNTS1
1215007BADTAPMCWBTMSG1         0299                        L073T921056MW86299   PNTS1
1216001       W                                            L067T9310562         PNTS1
1217007       MCWBTMSG2        0320                        L073U001056MX86320   PNTS1
1218002       CC                         A                 L068U021056FA        PNTS1
1219001       W                                            L067U0310562         PNTS1
1220001       CS                                           L067U041056/         PNTS1
1221001       CS                                           L067U051056/         PNTS1
1301001       H                                            L067U061056.         PNTS1
1302005       B  RENTR                   D                 L071U111056BU16D     PNTS1
1303004       B  MWERR                                     L070U151056BT14      PNTS1
1304005RENTR CU (U4                      MWRITE TAPE MARK  L071U201056U(U4M     PNTS1
1305005       CU (U4                     UUNLOAD TAPE 4    L071U251056U(U4U     PNTS1
1306004       B  MWERR                                     L070U291056BT14      PNTS1
1311005TWEOR CU (U4                      BBACKSPACE 4      L071U341056U(U4B     PNTS1
1312005       CU (U4                     MTAPE MARK 4      L071U391056U(U4M     PNTS1
1313005       CU (U4                     UUNLOAD 4         L071U441056U(U4U     PNTS1
1314007       MCWENTAP         0280                        L073U511056MV90280   PNTS1
1315002       CC                         A                 L068U531056FA        PNTS1
1316001       W                                            L067U5410562         PNTS1
1317001       CS                                           L067U551056/         PNTS1
1318001       CS                                           L067U561056/         PNTS1
1319001       H                                            L067U571056.         PNTS1
1320004       B  TWRITE                                    L070U611056B/31      PNTS1
8001003X1     DCW0089                                      L0260891056         FPNTS1
8002003NB2    DCW*         002                             L026U641056         FPNTS1
8003003ZERO3  DCW*         000                             L026U671056         FPNTS1
8004001CODES  DCW*                                         L024U681056         FPNTS1
8005002       DCW*         02                              L025U701056         FPNTS1
8006002       DCW*         03                              L025U721056         FPNTS1
8007002       DCW*         04                              L025U741056         FPNTS1
8008002       DCW*         05                              L025U761056         FPNTS1
8009002       DCW*         06                              L025U781056         FPNTS1
8010002       DCW*         08                              L025U801056         FPNTS1
8011002       DCW*         09                              L025U821056         FPNTS1
8012002       DCW*         13                              L025U841056         FPNTS1
8013002       DCW*         14                              L025U861056         FPNTS1
8014002       DCW*         22                              L025U881056         FPNTS1
8015002       DCW*         29                              L025U901056         FPNTS1
8016002       DCW*         34                              L025U921056         FPNTS1
8017002       DCW*         38                              L025U941056         FPNTS1
```

```
8018002       DCW*       42                                        L025U961056       FPNTS1
8019002       DCW*       69                                        L025U981056       FPNTS1
8101001GPMWDMDCW0959                                               L0249591056       FPNTS1
8102001GRPMKWDCW0189                                               L0241891056       FPNTS1
8103003TEMP   DCW*                                                 L026V011056       FPNTS1
8104003NB482  DCW*       482                                       L026V041056       FPNTS1
8105012BLANK  DCW*                                                 L035V161056       FPNTS1
8106001SKPCNTDCW*                                                  L024V171056       FPNTS1
8107001ERCNTRDCW*                                                  L024V181056       FPNTS1
8108001NB1    DCW*       1                                         L024V191056       FPNTS1
8110032       DCW*       END-OF-REEL ON OUTPUT TAPE 4              L055V511056       FPNTS1
8111032       DC  *      MOUNT NEW TAPE PRESS START TO COM055V831056               5PNTS1
8112007ENTAP  DC  *      NTINUE.                                   M030V901056       5PNTS1
8114032       DCW*       BAD TAPE ON 4  SET SWITCH D UP AL055W221056               FPNTS1
8115032       DC  *      ND PRESS START TO WRITE TAPE MARM055W541056               5PNTS1
8116032BTMSG1DC  *       K ON 4. UNPOAD TAPE 4 AND MOUNT M055W861056               5PNTS1
8117032       DCW*       NEW TAPE TO CONTINUE CR REPEAT FL055X181056               FPNTS1
8118032       DC  *      ROM BEGINNING WITH NEW TAPE ON 4M055X501056               5PNTS1
8119032       DC  *       OR SIMPLY PRESS START TO TRY AGM055X821056               5PNTS1
8120004BTMSG2DC  *       AIN.                                      M027X861056       5PNTS1
8121032EOR2M1DCW*        END OF REEL ON INPUT TAPE 2.              L055Y181056       FPNTS1
8122032EOR2M2DCW*        MOUNT NEXT INPUT TAPE ON UNIT 2.L055Y501056               FPNTS1
8123032EOR2M3DCW*        PRESS START TO CONTINUE -OR-              L055Y821056       FPNTS1
8124032EOR2M4DCW*        IF FINISHED LAST REEL -                   L055Z141056       FPNTS1
8125032EOR2M5DCW*        SET SWITCH D UP AND PRESS START L055Z461056               FPNTS1
8126032EOR2M6DCW*        TO WRITE TAPE MARK ON OUTPUT 4. L055Z781056               FPNTS1
99999          END1000                                             /‡000801056       JPNTS1
```

APPENDIX II

COMPUTER PROGRAMS FOR DATA ANALYSIS

The USNPGS Computer Facility was used to process the data for this study. Programs were written to compute the variables related to ship operations, and the graph subroutine on the computer library tape was used to draw the graphs. Ship movements were transferred from microfilm to data cards by using the numeric code:

O=Ship not deployed
1=Ship deployed, in port
2=Ship deployed, at sea

A 730 day record was made for each CVA so that the proper variables could be computed. The data cards from NASC were used directly as input for the computer. However, because of unidentified multiple punches in the last six columns of each card, these columns were erased and renumbered.

A. PROGRAM THESIS

This program computes the following variables related to ship operations for each accident:

1. Number of days at sea immediately prior to accident
2. Number of days in port immediately prior to accident
3. Number of days since beginning of deployment until accident
4. Number of days at sea since beginning of deployment until accident
5. Number of days in port since beginning of deployment until accident
6. Number of days after accident until deployment is over
7. Number of days since 1 January 1962 until accident
8. Number of days (regardless of deployed status) between accidents

If an accident occurred on deployment, all of the variables are computed. Otherwise, only certain applicable ones are computed and a note is written to this effect.

Input data consists of the coded ship movements using 80 columns of the card, each column representing the status for one day. Since this program was written for 730 days, this number appears in the program. These ship operating schedules are read into the computer in order of increasing ship hull numbers. The data for each accident is read from the NASC data cards. Routines for the various calculations are explained in comments in the program listing.

APPENDIX II A

```
-COOP,,POWELL,S/1S/2S,25,50000,4.
-FTN,L,E.
      PROGRAM THESIS
      TYPE INTEGER DATE, SHIP, A, B, C, D, E, F, G
      TYPE INTEGER H,FLT
      DIMENSION IDATE(300), DATE(730), ICVA(300), SHIP(730), I59(730),
     1I60(730), I61(730), I62(730), I63(730), I64(730), I65(730),
     1I41(730), I42(730), I43(730), I11(730), I14(730), I16(730),
     1I19(730), I31(730), I34(730), I38(730), A(300), B(300), C(300),
     1D(300), E(300), F(300), G(300), KK(300), LL(300), IND(300)
      DIMENSION IG(300), H(300), FLT(300)
      READ 2000, (I11(J), J=1,730)
      READ 2000, (I14(J), J=1,730)
      READ 2000, (I16(J), J=1,730)
      READ 2000, (I19(J), J=1,730)
      READ 2000, (I31(J), J=1,730)
      READ 2000, (I34(J), J=1,730)
      READ 2000, (I38(J), J=1,730)
      READ 2000, (I41(J), J=1,730)
      READ 2000, (I42(J), J=1,730)
      READ 2000, (I43(J), J=1,730)
      READ 2000, (I59(J), J=1,730)
      READ 2000, (I60(J), J=1,730)
      READ 2000, (I61(J), J=1,730)
      READ 2000, (I62(J), J=1,730)
      READ 2000, (I63(J), J=1,730)
      READ 2000, (I64(J), J=1,730)
      READ 2000, (I65(J), J=1,730)
 2000 FORMAT(80I1)
      DO 3000, I=1,300
      READ 3001, IDATE(I),KK(I),LL(I)
 3001 FORMAT (I5, A8, A8)
      READ 3002, ICVA(I)
 3002 FORMAT (66X, I2,/)
 3000 CONTINUE
C
C     DATES ARE SET SUCH THAT DATE(I) = 20101, DATE(365) = 21231,
```

```
C        DATE(366) = 30101, DATE(730) = 31231.
C
C        JANUARY 1962
         DATE(1) = 20101
         DO 1, I=1,30
         DATE(I+1)=DATE(I)+1
       1 CONTINUE
C        FEBRUARY 1962
         DATE(32)=20201
         DO 2 I=32,58
         DATE(I+1)=DATE(I)+1
       2 CONTINUE
C        MARCH 1962
         DATE(60)=20301
         DO 3 I=60,89
         DATE(I+1)=DATE(I)+1
       3 CONTINUE
C        APRIL 1962
         DATE(91)=20401
         DO 4 I=91,119
         DATE(I+1)=DATE(I)+1
       4 CONTINUE
C        MAY 1962
         DATE(121)=20501
         DO 5 I=121,150
         DATE(I+1)=DATE(I)+1
       5 CONTINUE
C        JUNE 1962
         DATE(152)=20601
         DO 6 I=152,180
         DATE(I+1)=DATE(I)+1
       6 CONTINUE
C        JULY 1962
         DATE(182)=20701
         DO 7 I=182,211
         DATE(I+1)=DATE(I)+1
       7 CONTINUE
```

```
C     AUGUST 1962
      DATE(213)=20801
      DO 8 I=213,242
      DATE(I+1)=DATE(I)+1
    8 CONTINUE
C     SEPTEMBER 1962
      DATE(244)=20901
      DO 9 I=244,272
      DATE(I+1)=DATE(I)+1
    9 CONTINUE
C     OCTOBER 1962
      DATE(274)=21001
      DO 10 I=274,303
      DATE(I+1)=DATE(I)+1
   10 CONTINUE
C     NOVEMBER 1962
      DATE(305)=21101
      DO 11 I=305,333
      DATE(I+1)=DATE(I)+1
   11 CONTINUE
C     DECEMBER 1962
      DATE(335)=21201
      DO 12 I=335,364
      DATE(I+1)=DATE(I)+1
   12 CONTINUE
C     JANUARY 1963
      DATE(366)=30101
      DO 13 I=366,395
      DATE(I+1)=DATE(I)+1
   13 CONTINUE
C     FEBRUARY 1963
      DATE(397)=30201
      DO 14 I=397,423
      DATE(I+1)=DATE(I)+1
   14 CONTINUE
C     MARCH 1963
      DATE(425)=30301
```

```
      DO 15 I=425,454
      DATE(I+1)=DATE(I)+1
   15 CONTINUE
C     APRIL 1963
      DATE(456)=30401
      DO 16 I=456,484
      DATE(I+1)=DATE(I)+1
   16 CONTINUE
C     MAY 1963
      DATE(486)=30501
      DO 17 I=486,515
      DATE(I+1)=DATE(I)+1
   17 CONTINUE
C     JUNE 1963
      DATE(517)=30601
      DO 18 I=517,545
      DATE(I+1)=DATE(I)+1
   18 CONTINUE
C     JULY 1963
      DATE(547)=30701
      DO 19 I=547,576
      DATE(I+1)=DATE(I)+1
   19 CONTINUE
C     AUGUST 1963
      DATE(578)=30801
      DO 20 I=578,607
      DATE(I+1)=DATE(I)+1
   20 CONTINUE
C     SEPTEMBER 1963
      DATE(609)=30901
      DO 21 I=609,637
      DATE(I+1)=DATE(I)+1
   21 CONTINUE
C     OCTOBER 1963
      DATE(639)=31001
      DO 22 I=639,668
      DATE(I+1)=DATE(I)+1
```

```
   22 CONTINUE
C     NOVEMBER 1963
      DATE(670)=31101
      DO 23 I=670,698
      DATE(I+1)=DATE(I)+1
   23 CONTINUE
C     DECEMBER 1963
      DATE(700)=31201
      DO 24 I=700,729
      DATE(I+1)=DATE(I)+1
   24 CONTINUE
      N=300
      DO 100 J=1,N
C     THE FOLLOWING ROUTINE DETERMINES THE CVA INVOLVED IN THE
C     ACCIDENT AND TRANSFERS THE OPERATING SCHEDULE TO THE RUNNING
C     VARIABLE, SHIP(I).
      IF(ICVA(J).EQ.59) 110,115
  110 DO 111 I=1,730
  111 SHIP(I)=I59(I)
      FLT(J)=6
      GO TO 200
  115 IF (ICVA(J).EQ.60) 116,120
  116 DO 117 I=1,730
  117 SHIP(I)=I60(I)
      FLT(J)=6
      GO TO 200
  120 IF(ICVA(J).EQ.61) 121,125
  121 DO 122 I=1,730
  122 SHIP(I)=I61(I)
      FLT(J)=7
      GO TO 200
  125 IF(ICVA(J).EQ.62) 126,130
  126 DO 127 I=1,730
  127 SHIP(I)=I62(I)
      FLT(J)=6
      GO TO 200
  130 IF(ICVA(J).EQ.63) 131,135
```

```
131 DO 132 I=1,730
132 SHIP(I)=I63(I)
    FLT(J)=7
    GO TO 200
135 IF(ICVA(J).EQ.64) 136,140
136 DO 137 I=1,730
137 SHIP(I)=I64(I)
    FLT(J)=7
    GO TO 200
140 IF(ICVA(J).EQ.65) 141,145
141 DO 142 I=1,730
142 SHIP(I)=I65(I)
    FLT(J)=6
    GO TO 200
145 IF(ICVA(J).EQ.41) 146,150
146 DO 147 I=1,730
147 SHIP(I)=I41(I)
    FLT(J)=7
    GO TO 200
150 IF(ICVA(J).EQ.42) 151,155
151 DO 152 I=1,730
152 SHIP(I)=I42(I)
    FLT(J)=6
    GO TO 200
155 IF(ICVA(J).EQ.43) 156,160
156 DO 157 I=1,730
157 SHIP(I)=I43(I)
    FLT(J)=7
    GO TO 200
160 IF(ICVA(J).EQ.11) 161,165
161 DO 162 I=1,730
162 SHIP(I)=I11(I)
    FLT(J)=6
    GO TO 200
165 IF(ICVA(J).EQ.14) 166,170
166 DO 167 I=1,730
167 SHIP(I)=I14(I)
```

APPENDIX II A

```
      FLT(J)=7
      GO TO 200
  170 IF(ICVA(J).EQ.16) 171,175
  171 DO 172 I=1,730
  172 SHIP(I)=I16(I)
      FLT(J)=7
      GO TO 200
  175 IF(ICVA(J).EQ.19) 176,180
  176 DO 177 I=1,730
  177 SHIP(I)=I19(I)
      FLT(J)=7
      GO TO 200
  180 IF(ICVA(J).EQ.31) 181,185
  181 DO 182 I=1,730
  182 SHIP(I)=I31(I)
      FLT(J)=7
      GO TO 200
  185 IF(ICVA(J).EQ.34) 186,190
  186 DO 187 I=1,730
  187 SHIP(I)=I34(I)
      FLT(J)=7
      GO TO 200
  190 IF(ICVA(J).EQ.38) 191,100
  191 DO 192 I=1,730
  192 SHIP(I)=I38(I)
      FLT(J)=6
      GO TO 200
C     THE FOLLOWING ARE COMPUTED USING A CODED OPERATING SCHEDULE,
C     0=SHIP NOT DEPLOYED, 1=SHIP DEPLOYED IN PORT, 2=SHIP DEPLOYED
C     AT SEA.
C     A(J)=NUMBER OF DAYS AT SEA IMMEDIATELY PRIOR TO ACCIDENT
C     B(J)=NUMBER OF DAYS IN PORT IMMEDIATEDL PRIOR TO ACCIDENT
C     C(J)=NUMBER OF DAYS SINCE BEGINNING OF DEPLOYMENT UNTIL ACCIDENT
C     D(J)=NUMBER OF DAYS AT SEA SINCE BEGINNING OF DEPLOYMENT UNTIL
C     ACCIDENT
C     E(J)=NUMBER OF DAYS IN PORT SINCE BEGINNING OF DEPLOYMENT UNTIL
C     ACCIDENT
```

APPENDIX II A

```
C      F(J)=NUMBER OF DAYS AFTER ACCIDENT UNTIL DEPLOYMENT IS OVER
C      G(J)=NUMBER OF DAYS SINCE 1 JANUARY 1962 UNTIL ACCIDENT
C      H(J)=NUMBER OF DAYS (REGARDLESS OF DEPLOYMENT) BETWEEN ACCIDENTS
C
  200 A(J)=0
      B(J)=0
      C(J)=0
      D(J)=0
      E(J)=0
      F(J)=0
      G(J)=0
      DO 205 I=1,730
      IF(IDATE(J).EQ.DATE(I)) 210,205
  210 G(J)=I
      IF(SHIP(I).EQ.0) 1111,211
 1111 IND(J)=56
      GO TO 100
  211 IND(J)=0
C     A(J) IS COMPUTED AS FOLLOWS
      DO 215 K=1,100
      K1=K-1
      IF((I-K1).EQ.0)220,216
  216 IF(SHIP(I-K1).EQ.2) 217,220
  217 A(J)=A(J)+1
  215 CONTINUE
C     B(J) IS COMPUTED AS FOLLOWS
  220 DO 225 K=1,100
      K1=K-1+A(J)
      IF((I-K1).EQ.0) 230,226
  226 IF(SHIP(I-K1).EQ.1) 227,230
  227 B(J)= B(J)+1
  225 CONTINUE
C     D(J) IS COMPUTED AS FOLLOWS
  230 DO 231 K=1,730
      K1=K-1
      IF((I-K1).EQ.0) 240,232
  232 IF(SHIP(I-K1).EQ.0) 240,233
```

APPENDIX II A

```
  233 IF(SHIP(I-K1).EQ.2) 234,231
  234 D(J)=D(J)+1
  231 CONTINUE
C     E(J) IS COMPUTED AS FOLLOWS
  240 DO 241 L=1,730
      K=L-1
      IF((I-K).EQ.0) 250,242
  242 IF(SHIP(I-K).EQ.0) 250,243
  243 IF(SHIP(I-K).EQ.1) 244,241
  244 E(J)=E(J)+1
  241 CONTINUE
C     C(J) IS COMPUTED AS FOLLOWS
  250 DO 251 L=1,730
      K=L-1
      IF((I-K).EQ.0) 260,252
  252 IF(SHIP(I-K).EQ.0) 260,253
  253 C(J)=C(J)+1
  251 CONTINUE
      K=0
C     F(J) IS COMPUTED AS FOLLOWS
  260 DO 261 K=1,730
      IF((I+K).GT.730) 100,262
  262 IF(SHIP(I+K).EQ.0) 100,263
  263 F(J)=F(J)+1
  261 CONTINUE
  205 CONTINUE
  100 CONTINUE
C
      DO 4000 I=1,N
 4000 IG(I)=G(I)
      L=N-1
      DO 4001 I=1,L
      JJ=N-I
      DO 4002 J=1,JJ
      IF(IG(J)-IG(JJ+1)) 4002,4002,4003
 4003 MM=IG(JJ+1)
      IG(JJ+1)=IG(J)
```

```
      IG(J)=MM
 4002 CONTINUE
 4001 CONTINUE
      DO 4005 J=1,N
      DO 4010 I=1,N
      IF(G(J).EQ.IG(I)) 4011,4010
 4011 IF(G(J).EQ.IG(1)) 4012,4013
 4012 H(J)=G(J)
      GO TO 4005
 4013 MM=IG(I)-IG(I-1)
      H(J)=MM
      GO TO 4005
 4010 CONTINUE
 4005 CONTINUE
C
      PRINT 500
  500 FORMAT(1H1,45X,29HOPERATING SCHEDULES 1962,1963)
      PRINT 501
  501 FORMAT(1H0,20H0 = CVA NOT DEPLOYED)
      PRINT 502
  502 FORMAT(1X,28H1 = CVA DEPLOYED AND IN PORT)
      PRINT 503
  503 FORMAT(1X,27H2 = CVA DEPLOYED AND AT SEA)
      PRINT 509
  509 FORMAT(1X,21HDATE = YEAR,MONTH,DAY)
      DO 504 I=1,4
  504 PRINT 505
  505 FORMAT(1H )
      PRINT 506
  506 FORMAT(24X,11HSIXTH FLEET,48X,13HSEVENTH FLEET)
      PRINT 507
  507 FORMAT(1H0,4HDATE,1X,7(2X,3HCVA),18X,4HDATE,1X,10(2X,3HCVA))
      PRINT 508
  508 FORMAT(8X,2H11,3X,2H38,3X,2H42,3X,2H59,3X,2H60,3X,2H62,3X,2H65,
     126X,2H14,3X,2H16,3X,2H19,3X,2H31,3X,2H34,3X,2H41,3X,2H43,3X,
     12H61,3X,2H63,3X,2H64)
      DO 510 I=1,2
```

APPENDIX II A

```
510 PRINT 511
511 FORMAT(1X,119(1H-))
     DO 512 I=1,730
     PRINT 513,DATE(I),I11(I),I38(I),I42(I),I59(I),I60(I),I62(I),
    1I65(I),DATE(I),I14(I),I16(I),I19(I),I31(I),I34(I),I41(I),I43(I),
    1I61(I),I63(I),I64(I)
513 FORMAT(1X,I5,3X,7(I1,4X),15X,I5,3X,10(I1,4X))
     PRINT 514
514 FORMAT(1X,119(1H-))
512 CONTINUE
     PRINT 600
600 FORMAT(1H1,29HLISTING OF COMPUTED VARIABLES)
     PRINT 601
601 FORMAT(1H0,4HCODE)
     PRINT 602
602 FORMAT(1X,55HA = NUMBER OF DAYS AT SEA IMMEDIATELY PRIOR TO ACCIDE
    1NT)
     PRINT 603
603 FORMAT(1X,56HB = NUMBER OF DAYS IN PORT IMMEDIATELY PRIOR TO ACCID
    1ENT)
     PRINT 604
604 FORMAT(1X,63HC = NUMBER OF DAYS SINCE BEGINNING OF DEPLOYMENT UNTI
    1L ACCIDENT)
     PRINT 605
605 FORMAT(1X,70HD = NUMBER OF DAYS AT SEA SINCE BEGINNING OF DEPLOYME
    1NT UNTIL ACCIDENT)
     PRINT 606
606 FORMAT(1X,71HE = NUMBER OF DAYS IN PORT SINCE BEGINNING OF DEPLOYM
    1ENT UNTIL ACCIDENT)
     PRINT 607
607 FORMAT(1X,58HF = NUMBER OF DAYS AFTER ACCIDENT UNTIL DEPLOYMENT IS
    1 OVER)
     PRINT 608
608 FORMAT(1X,54HG = NUMBER OF DAYS SINCE 1 JANUARY 1962 UNTIL ACCIDEN
    1T)
     PRINT 630
630 FORMAT(1X,63HH = NUMBER OF DAYS (REGARDLESS OF DEPLOYMENT) BETWEEN
```

APPENDIX II A

```
      1 ACCIDENTS)
       PRINT 609
   609 FORMAT(1H0,4HNASC)
       PRINT 610
   610 FORMAT(1X,10HIDENTIFIER,16X,1HA,5X,1HB,5X,1HC,5X,1HD,5X,1HE,5X,
      11HF,5X,1HG, 5X,1HH,4X,3HCVA,3X,5HFLEET)
       PRINT 611
       PRINT 611
   611 FORMAT(1X,119(1H-))
       DO 620 J=1,300
       IF(IND(J).EQ.0) 621,622
   621 PRINT 623,IDATE(J),KK(J),LL(J),A(J),B(J),C(J),D(J),E(J),F(J),G(J),
      1H(J),ICVA(J),FLT(J)
   623 FORMAT(1X,I5,A8,A8,3X,8(I3,3X),1X,I2,6X,I1)
       GO TO 625
   622 PRINT 624,IDATE(J),KK(J),LL(J),G(J),H(J),ICVA(J)
   624 FORMAT(1X,I5,A8,A8,1X,36HACCIDENT DID NOT OCCUR ON DEPLOYMENT,2X,
      12(I3,3X),1X,I2)
   625 PRINT 514
   620 CONTINUE
       END
           END
           FINIS
-EXECUTE.
```

B. PROGRAM PLOT

The following two programs draw graphs from the NASC data. The nature of each graph is explained by comments in the program listing. Input data cards are the sets of three NASC cards per accident. The value for N(statement 6) is the number of accidents to be plotted. In those cases where the input format is alphabetic, test variables are written into the program in "A" fields. The actual data is also read into the computer in "A" fields and tested against the test variables. The results of the tests determine the floating point value which will be assigned to the variable.

APPENDIX II B

```
..JOB0161F,POWELL, W.W.
      PROGRAM PLOT
      DIMENSION X(900), Y(900), DATA(304), ITITLE(12)
      DIMENSION IDATE(304), ITPT(304), ITIT(304)
      DIMENSION ITL3M(304), ITITL3M(304), INTL3M(304)
      DIMENSION ITIME(304), IRANK(304)
      N=300
      DO 1000 I=1,N
      READ 1001, IDATE(I), ITIME(I)
 1001 FORMAT ( I1, 27X, I1)
      PRINT 3000,IDATE(I),ITIME(I)
 3000 FORMAT(1X,I1,I1)
      READ 1002, IRANK(I),ITPT(I),ITL3M(I),ITIT(I),ITITL3M(I),INTL3M(I)
 1002 FORMAT (/,31X,I1,23X,I2,I2,2X,I2,1X,I2,4X,I2)
      PRINT 3001,IRANK(I),ITPT(I),ITL3M(I),ITIT(I),ITITL3M(I),INTL3M(I)
 3001 FORMAT(1X,6I4)
 1000 CONTINUE
C GRAPHS G1 THROUGH G8 ARE FOR THE COMBINED FLEETS FOR 1962 AND 1963
C UNLESS OTHERWISE SPECIFIED
C
C GRAPH G1 PLOTS TOTAL PILOT TIME VS. NUMBER OF ACCIDENTS
C
      XINC = 500.
      INT = 15
      DO 1 I = 1,N
      ITPT(I) = ITPT(I)*100 + 50
      DATA(I) = ITPT(I)
    1 CONTINUE
      DO 2 I = 1,12
    2 ITITLE(I) = 8H
      ITITLE(1)=8H POWELL
      ITITLE(2)=8HW. W.
      ITITLE(7) = 8HG1
      X(1) = 0.0
      Y(1) = 0.0
      LQ=4H
      DO 3 I = 1,INT
```

```
      X(I+1) = X(I) + XINC
      Y(I+1) = 0.0
    3 CONTINUE
      DO 4 J = 1,N
      DO 5 I = 1,INT
      IF( DATA(J)- X(I)) 6,6,5
    6 Y(I) = Y(I) + 1.0
      GO TO 4
    5 CONTINUE
    4 CONTINUE
      DO 7 I = 1,INT
    7 X(I) = X(I) - XINC/2.0
      CALL DRAW(INT,X,Y,0,0,LQ,ITITLE,0,0,0,0,0,0,5,5,1,LAST)
C
C GRAPH G2 PLOTS TOTAL PILOT TIME VS. NUMBER OF ACCIDENTS FOR 1962
C
      X(1) = 0.0
      Y(1) = 0.0
      DO 10 I = 1,INT
      X(I+1) = X(I) + XINC
      Y(I+1) = 0.0
   10 CONTINUE
      ITITLE(7) = 8HG2
      LQ=4H
      DO 11 J = 1,N
      IF(IDATE(J)-2) 13,13,11
   13 DO 12 I = 1,INT
      IF(DATA(J)-X(I)) 14,14,12
   14 Y(I) = Y(I) + 1.0
      GO TO 11
   12 CONTINUE
   11 CONTINUE
      DO 15 I = 1,INT
   15 X(I) = X(I) - XINC/2.0
      CALL DRAW(INT,X,Y,0,0,LQ,ITITLE,0,0,0,0,0,0,5,5,1,LAST)
C
C GRAPH G3 PLOTS TOTAL PILOT TIME VS. NUMBER OF ACCIDENTS FOR 1963
```

APPENDIX II B

```
C
      X(1) = 0.0
      Y(1) = 0.0
      DO 20 I = 1,INT
      X(I+1) = X(I) + XINC
      Y(I+1) = 0.0
   20 CONTINUE
      ITITLE(7) = 8HG3
      LQ=4H
      DO 21 J = 1,N
      IF(IDATE(J)-3) 23,23,21
   23 DO 22 I = 1,INT
      IF(DATA(J)-X(I)) 24,24,22
   24 Y(I) = Y(I) + 1.0
      GO TO 21
   22 CONTINUE
   21 CONTINUE
      DO 25 I = 1,INT
   25 X(I) = X(I) - XINC/2.0
      CALL DRAW(INT,X,Y,0,0,LQ,ITITLE,0,0,0,0,0,0,5,5,1,LAST)
C
C GRAPH G4 PLOTS TIME IN TYPE AIRCRAFT VS. NUMBER OF ACCIDENTS
C
      DO 70 I = 1,N
      ITIT(I) = ITIT(I)*10 + 5
      DATA(I) = ITIT(I)
   70 CONTINUE
      XINC=100.0
      INT=15
      ITITLE(7) = 8HG4
      LQ=4H
      X(1) = 0.0
      Y(1) = 0.0
      DO 71 I = 1,INT
      X(I+1) = X(I) + XINC
      Y(I+1) = 0.0
   71 CONTINUE
```

```
      DO 74 J = 1,N
      DO 75 I = 1,INT
      IF(DATA(J)-X(I)) 76,76,75
   76 Y(I) = Y(I) + 1.0
      GO TO 74
   75 CONTINUE
   74 CONTINUE
      DO 77 I = 1,INT
   77 X(I) = X(I) - XINC/2.0
      CALL DRAW(INT,X,Y,0,0,LQ,ITITLE,0,0,0,0,0,0,5,5,1,LAST)
C
C GRAPH G5 PLOTS TIME LAST THREE MONTHS VS. NUMBER OF ACCIDENTS
C
      DO 80 I = 1,N
      ITL3M(I) = ITL3M(I)*10 + 5
      DATA(I) = ITL3M(I)
   80 CONTINUE
      XINC = 20.
      INT = 20
      ITITLE(7) = 8HG5
      LQ=4H
      X(1) = 0.0
      Y(1) = 0.0
      DO 81 I = 1,INT
      X(I+1) = X(I) + XINC
      Y(I+1) = 0.0
   81 CONTINUE
      DO 84 J = 1,N
      DO 85 I = 1,INT
      IF(DATA(J)-X(I)) 86,86,85
   86 Y(I) = Y(I) + 1.0
      GO TO 84
   85 CONTINUE
   84 CONTINUE
      DO 87 I = 1,INT
   87 X(I) = X(I) - XINC/2.0
      CALL DRAW(INT,X,Y,0,0,LQ,ITITLE,0,0,0,0,0,0,5,5,1,LAST)
```

APPENDIX II B

```
C
C GRAPH G6 PLOTS TIME IN TYPE LAST THREE MONTHS VS. NUMBER OF ACCIDENTS
C
      DO 90 I = 1,N
      ITITL3M(I) = ITITL3M(I)*10 + 5
      DATA(I) = ITITL3M(I)
   90 CONTINUE
      ITITLE(7) = 8HG6
      LQ=4H
      X(1) = 0.0
      Y(1) = 0.0
      DO 91 I = 1,INT
      X(I+1) = X(I) + XINC
      Y(I+1) = 0.0
   91 CONTINUE
      DO 94 J = 1,N
      DO 95 I = 1,INT
      IF(DATA(J)-X(I)) 96,96,95
   96 Y(I) = Y(I) + 1.0
      GO TO 94
   95 CONTINUE
   94 CONTINUE
      DO 97 I = 1,INT
   97 X(I) = X(I) - XINC/2.0
      CALL DRAW(INT,X,Y,0,0,LQ,ITITLE,0,0,0,0,0,0,5,5,1,LAST)
C
C GRAPH G7 PLOTS NIGHT TIME LAST THREE MONTHS VS. NUMBER OF NIGHT ACCIDENTS
C
      XINC = 5.0
      INT = 20
      DO 100 I = 1,N
  100 DATA(I) = INTL3M(I)
      ITITLE(7) = 8HG7
      LQ=4H
      X(1) = 0.0
      Y(1) = 0.0
      DO 103 I = 1,INT
```

UNCLASSIFIED

APPENDIX II B

```
      X(I+1) = X(I) + XINC
      Y(I+1) = 0.0
  103 CONTINUE
      NUMBER = 0
      DO 104 J=1,N
      IF(ITIME(J)-4) 104,105,104
  105 NUMBER = NUMBER + 1
      DO 106 I = 1,INT
      IF(DATA(J)-X(I)) 107,107,106
  107 Y(I) = Y(I) + 1.0
      GO TO 104
  106 CONTINUE
  104 CONTINUE
      DO 108 I = 1,INT
  108 X(I) = X(I)-XINC/2.0
      CALL DRAW(INT,X,Y,0,0,LQ,ITITLE,0,0,0,0,0,0,5,5,1,LAST)
C
C GRAPH G8 PLOTS PILOTS RANK VS. NUMBER OF ACCIDENTS
C
      XINC = 1.0
      INT = 10
      DO 110 I=1,N
  110 DATA(I) = IRANK(I)
      ITITLE(7) = 8HG8
      LQ=4H
      X(1) = 0.0
      Y(1) = 0.0
      DO 113 I = 1,INT
      X(I+1) = X(I) + XINC
      Y(I+1) = 0.0
  113 CONTINUE
      DO 114 J = 1,N
      DO 115 I=1,INT
      IF(DATA(J)-X(I)) 115,116,115
  116 Y(I) = Y(I) + 1.0
      GO TO 114
  115 CONTINUE
```

```
  114 CONTINUE
      CALL DRAW(INT,X,Y,0,5,LQ,ITITLE,0,0,0,0,0,0,5,5,1,LAST)
C
C
C
      PRINT 2000, NUMBER
 2000 FORMAT(1H1,32HTHE NUMBER OF NIGHT ACCIDENTS = ,I3)
      DO 2001 I = 1,N
 2001 IDATE(I) = IDATE(I) + 1960
      PRINT 2002
 2002 FORMAT(1H0,4HDATE,5X,4HRANK,6X,3HTPT,7X,4HTL3M,6X,3HTIT,7X,
     16HTITL3M,4X,5HNTL3M,/)
      DO 2003 I = 1,N
 2003 PRINT 2004,IDATE(I),IRANK(I),ITPT(I),ITL3M(I),ITIT(I),
     1ITITL3M(I),INTL3M(I)
 2004 FORMAT(1X,I4,5X,I1,9X,I4,6X,I3,7X,I4,6X,I3,7X,I3)
      STOP
      END
      END
```

APPENDIX II B

```
..JOB0161F,POWELL
      PROGRAM PLOT
      DIMENSION LANDT(13),LAND(300),DATA(300),ITITLE(12),X(900),Y(900),
     1IYRST(13),IYRS(300),IWEA(1500),INST(300),IPHASE(300),INJ(300),
     1IDAM(300),IOPERS(600)
      N=300
      READ 1000,(LANDT(I),I=1,13)
 1000 FORMAT(13A1)
      READ 1000,(IYRST(I),I=1,13)
      READ 1001,IWEAT
 1001 FORMAT(A1)
      READ 1002,INJT1,INJT2
 1002 FORMAT(2A1)
      READ 1003,IDAMT1,IDAMT2,IDAMT3
 1003 FORMAT(3A1)
      READ 1004,IOPERST
 1004 FORMAT(A2)
      DO 1005 I=1,N
      II=5*I-4
      JJ=5*I-3
      KK=5*I-2
      LL=5*I-1
      MM=5*I
      III=2*I-1
      JJJ=2*I
      READ 1006,IDAM(I),INJ(I),IPHASE(I),IWEA(II),IWEA(JJ),IWEA(KK),
     1IWEA(LL),IWEA(MM),IOPERS(III),IOPERS(JJJ)
 1006 FORMAT(8X,A1,A1,22X,I1,9X,5A1,6X,2A2)
      READ 1007,IYRS(I),LAND(I),INST(I)
 1007 FORMAT(/,39X,A1,27X,A1,I2)
 1005 CONTINUE
      DO 600 I=1,12
  600 ITITLE(I)=8H
      ITITLE(1)=8HPOWELL
      ITITLE(2)=8HW.W.
C
C GRAPH G9 PLOTS NUMBER OF ACCIDENTS VS. NUMBER OF CV LANDINGS
```

APPENDIX II B

```
C
      XINC=50.0
      INT=10
      DO 1 I=1,N
      IF(LAND(I)-LANDT(1))2,3,2
    3 DATA(I)=5.
      GO TO 1
    2 IF(LAND(I)-LANDT(2))4,5,4
    5 DATA(I)=15.
      GO TO 1
    4 IF(LAND(I)-LANDT(3))6,7,6
    7 DATA(I)=25.
      GO TO 1
    6 IF(LAND(I)-LANDT(4))8,9,8
    9 DATA(I)=35.
      GO TO 1
    8 IF(LAND(I)-LANDT(5))10,11,10
   11 DATA(I)=45.
      GO TO 1
   10 IF(LAND(I)-LANDT(6))12,13,12
   13 DATA(I)=55.
      GO TO 1
   12 IF(LAND(I)-LANDT(7))14,15,14
   15 DATA(I)=65.
      GO TO 1
   14 IF(LAND(I)-LANDT(8))16,17,16
   17 DATA(I)=75.
      GO TO 1
   16 IF(LAND(I)-LANDT(9))18,19,18
   19 DATA(I)=85.
      GO TO 1
   18 IF(LAND(I)-LANDT(10))20,21,20
   21 DATA(I)=95.
      GO TO 1
   20 IF(LAND(I)-LANDT(11))22,23,22
   23 DATA(I)=150.
      GO TO 1
```

```
   22 IF(LAND(I)-LANDT(12))24,25,24
   25 DATA(I)=350.
      GO TO 1
   24 IF(LAND(I)-LANDT(13))26,27,26
   27 DATA(I)=500.
      GO TO 1
   26 DATA(I)=0.
    1 CONTINUE
      ITITLE(7)=8HG9
      X(1)=0.0
      Y(1)=0.0
      LQ=4H
      DO 40 I=1,INT
      X(I+1)=X(I)+XINC
      Y(I+1)=0.0
   40 CONTINUE
      DO 41 J=1,N
      DO 42 I=1,INT
      IF (DATA(J)-X(I))44,44,42
   44 Y(I)=Y(I)+1.0
      GO TO 41
   42 CONTINUE
   41 CONTINUE
      CALL DRAW(INT,X,Y,0,0,LQ,ITITLE,0,0,0,0,0,0,5,5,1,LAST)
C
C GRAPH G10 PLOTS NUMBER OF ACCIDENTS VS. YEARS MILITARY FLYING
C
      XINC=5.0
      INT=6
      DO 100 I=1,N
      IF(IYRS(I)-IYRST(1))101,102,101
  102 DATA(I)=0.0
      GO TO 100
  101 IF(IYRS(I)-IYRST(2))103,104,103
  104 DATA(I)=1.
      GO TO 100
  103 IF(IYRS(I)-IYRST(3))105,106,105
```

```
106 DATA(I)=2.0
    GO TO 100
105 IF(IYRS(I)-IYRST(4))107,108,107
108 DATA(I)=3.0
    GO TO 100
107 IF(IYRS(I)-IYRST(5))109,110,109
110 DATA(I)=4.
    GO TO 100
109 IF(IYRS(I)-IYRST(6))111,112,111
112 DATA(I)=5.0
    GO TO 100
111 IF(IYRS(I)-IYRST(7))113,114,113
114 DATA(I)=6.0
    GO TO 100
113 IF(IYRS(I)-IYRST(8))115,116,115
116 DATA(I)=7.0
    GO TO 100
115 IF(IYRS(I)-IYRST(9))117,118,117
118 DATA(I)=8.0
    GO TO 100
117 IF(IYRS(I)-IYRST(10))119,120,119
120 DATA(I)=9.0
    GO TO 100
119 IF(IYRS(I)-IYRST(11))121,122,121
122 DATA(I)=12.
    GO TO 100
121 IF(IYRS(I)-IYRST(12))123,124,123
124 DATA(I)=17.5
    GO TO 100
123 IF(IYRS(I)-IYRST(13))125,126,125
126 DATA(I)=22.
    GO TO 100
125 DATA(I)=0.0
    GO TO 100
100 CONTINUE
    ITITLE(7)=8HG10
    LQ=4H
```

APPENDIX II B

```
      X(1)=0.0
      Y(1)=0.0
      DO 130 I=1,INT
      X(I+1)=X(I)+XINC
      Y(I+1)=0.0
  130 CONTINUE
      DO 134 J=1,N
      DO 135 I=1,INT
      IF(DATA(J)-X(I))136,136,135
  136 Y(I)=Y(I)+1.0
      GO TO 134
  135 CONTINUE
  134 CONTINUE
      CALL DRAW(INT,X,Y,0,0,LQ,ITITLE,0,0,0,0,0,0,5,5,1,L1ST)
C
C GRAPH G11 PLOTS NUMBER OF ACCIDENTS VS. INSTRUMENT HOURS LAST THREE
C MONTHS FOR ACCIDENTS INVOLVING WEATHER
C
      NN=0
      DO 200 I=1,N
      M=I*5-4
      L=I*5
      DO 201 J=M,L
      IF(IWEA(J)-IWEAT)201,203,201
  203 NN=NN+1
      DATA(NN)=INST(I)
  201 CONTINUE
  200 CONTINUE
      XINC=5.0
      INT=6
      ITITLE(7)=8HG11
      LQ=4H
      X(1)=0.0
      Y(1)=0.0
      DO 210 I=1,INT
      X(I+1)=X(I)+XINC
      Y(I+1)=0.0
```

```
  210 CONTINUE
      DO 214 J=1,NN
      DO 215 I=1,INT
      IF(DATA(J)-X(I))216,216,215
  216 Y(I)=Y(I)+1.0
      GO TO 214
  215 CONTINUE
  214 CONTINUE
      CALL DRAW(INT,X,Y,0,0,LQ,ITITLE,0,0,0,0,0,0,5,5,1,LAST)
C
C GRAPH G12 PLOTS NUMBER OF ACCIDENTS VS. PHASE OF OPERATION
C 0=UNDETERMINED
C 1=STATIC INCIDENT TO FLIGHT
C 2=TAXIING INCIDENT TO FLIGHT
C 3=TAKEOFF
C 4=INFLIGHT
C 5=LANDING
C 6=WAVEOFF
C
      DO 300 I=1,N
  300 DATA(I)=IPHASE(I)
      XINC=1.0
      INT=7
      ITITLE(7)=8HG12
      LQ=4H
      X(1)=0.0
      Y(1)=0.0
      DO 301 I=1,INT
      X(I+1)=X(I)+XINC
      Y(I+1)=0.0
  301 CONTINUE
      DO 304 J=1,N
      DO 305 I=1,INT
      IF(DATA(J)-X(I))305,306,305
  306 Y(I)=Y(I)+1.0
      GO TO 304
  305 CONTINUE
```

APPENDIX II B

```
  304 CONTINUE
      CALL DRAW(INT,X,Y,0,1,LQ,ITITLE,0,0,0,0,0,0,5,5,1,LAST)
C
C GRAPH G13 PLOTS NUMBER OF ACCIDENTS VS...
C 1=FATALITIES OR UNKNOWNS
C 2=ALFA DAMAGE
C 3=BRAVO DAMAGE
C 4=CHARLIE DAMAGE
C 5=PILOT AS A CAUSE FACTOR
C 6=LSO AS A RELATED VARIABLE
C 7=CVA AS A CONTRIBUTING CAUSE FACTOR
C 8=PITCHING DECK AS A CONTRIBUTING CAUSE FACTOR
C
      XINC=1.0
      INT=8
      ITITLE(7)=8HG13
      LQ=4H
      X(1)=0.0
      Y(1)=0.0
      DO 400 I=1,INT
      X(I+1)=X(I)+XINC
      Y(I+1)=0.0
  400 CONTINUE
      DO 401 I=1,N
      IF(INJ(I)-INJT1)402,403,402
  403 Y(2)=Y(2)+1.0
      GO TO 404
  402 IF(INJ(I)-INJT2)404,405,404
  405 Y(2)=Y(2)+1.0
  404 IF(IDAM(I)-IDAMT1)406,407,406
  407 Y(3)=Y(3)+1.0
      GO TO 410
  406 IF(IDAM(I)-IDAMT2)408,409,408
  409 Y(4)=Y(4)+1.0
      GO TO 410
  408 IF(IDAM(I)-IDAMT3)410,411,410
  411 Y(5)=Y(5)+1.0
```

```
410 L=5*I-4
    M=5*I
    DO 412  J=L,M
    IF(IWEA(J)-LANDT(2))413,414,413
414 Y(6)=Y(6)+1.0
413 IF(IWEA(J)-LANDT(10))412,416,412
416 Y(8)=Y(8)+1.0
412 CONTINUE
    L=2*I-1
    M=2*I
    DO 421  J=L,M
    IF(IOPERS(J)-IOPERST)421,422,421
422 Y(7)=Y(7)+1.0
421 CONTINUE
401 CONTINUE
    CALL DRAW(INT,X,Y,0,1,LQ,ITITLE,0,0,0,0,0,0,5,5,1,LAST)
    STOP
    END
    END

0123456789ABC
0123456789AJB
7
AU
ABC
B1
```

C. PROGRAM PLOT

The following two programs draw graphs of the data computed in PROGRAM THESIS. The graphs are explained in appropriate comments in the program listings. Input consists of the computed variables as identified in THESIS. N is the number of accidents. The programs print the input data as output as a check on the results.

APPENDIX II C

```
..JOB0161F,POWELL,W.W.
      PROGRAM PLOT
      DIMENSION A(300),B(300),C(300),D(300),E(300),F(300),G(300),
     1ITITLE(12),X(900),Y(900)
      DIMENSION H(300)
      N=173
      PRINT 1002
 1002 FORMAT(1H1,3X,1HA,3X,1HB,3X,1HC,3X,1HD,3X,1HE,3X,1HF,3X,1HG,3X,
     11HH)
      DO 1000 I=1,N
      READ 1001,A(I),B(I),C(I),D(I),E(I),F(I),G(I),H(I)
 1001 FORMAT(21X,8F4.0)
      PRINT 1003,A(I),B(I),C(I),D(I),E(I),F(I),G(I),H(I)
 1003 FORMAT(1X,8F4.0)
 1000 CONTINUE
C
C GRAPH G14 PLOTS NUMBER OF ACCIDENTS VS. NUMBER OF DAYS AT SEA IMMEDIATELY
C PRIOR TO ACCIDENT
C
      DO 1 I=1,12
    1 ITITLE(I)=8H
      ITITLE(1)=8HPOWELL
      ITITLE(2)=8HW.W.
      ITITLE(7)=8HG14
      XINC=5.0
      INT=6
      X(1)=0.0
      Y(1)=0.0
      LQ=4H
      DO 3 I=1,INT
      X(I+1)=X(I)+XINC
      Y(I+1)=0.0
    3 CONTINUE
      DO 4 J=1,N
      DO 5 I=1,INT
      IF(A(J)-0.0)9,4,9
    9 IF(A(J)-X(I))6,6,5
```

```
    6 Y(I)=Y(I)+1.0
      GO TO 4
    5 CONTINUE
    4 CONTINUE
      CALL DRAW(INT,X,Y,0,0,LQ,ITITLE,0,0,0,0,0,0,5,5,1,LAST)
C
C GRAPH G15 PLOTS NUMBER OF ACCIDENTS VS. NUMBER OF DAYS IN PORT IMMEDIATELY
C PRIOR TO ACCIDENT
C
      ITITLE(7)=8HG15
      X(1)=0.0
      Y(1)=0.0
      LQ=4H
      DO 11 I=1,INT
      X(I+1)=X(I)+XINC
      Y(I+1)=0.0
   11 CONTINUE
      DO 14 J=1,N
      DO 15 I=1,INT
      IF(B(J)-0.0)19,14,19
   19 IF(B(J)-X(I))16,16,15
   16 Y(I)=Y(I)+1.0
      GO TO 14
   15 CONTINUE
   14 CONTINUE
      CALL DRAW(INT,X,Y,0,0,LQ,ITITLE,0,0,0,0,0,0,5,5,1,LAST)
C
C GRAPH G16 PLOTS NUMBER OF ACCIDENTS VS. NUMBER OF DAYS SINCE BEGINNING OF
C DEPLOYMENT UNTIL ACCIDENT
C
      ITITLE(7)=8HG16
      LQ=4H
      XINC=30.0
      INT=7
      Y(1)=0.0
      X(1)=0.0
      DO 21 I=1,INT
```

```
      X(I+1)=X(I)+XINC
      Y(I+1)=0.0
   21 CONTINUE
      DO 24 J=1,N
      DO 25 I=1,INT
      IF(C(J)-0.0)29,24,29
   29 IF(C(J)-X(I))26,26,25
   26 Y(I)=Y(I)+1.0
      GO TO 24
   25 CONTINUE
   24 CONTINUE
      CALL DRAW(INT,X,Y,0,0,LQ,ITITLE,0,0,0,0,0,0,5,5,1,LAST)
C
C GRAPH G17 PLOTS NUMBER OF ACCIDENTS VS. NUMBER OF DAYS AT SEA SINCE
C BEGINNING OF DEPLOYMENT UNTIL ACCIDENT
C
      XINC=15.0
      INT=10
      ITITLE(7)=8HG17
      LQ=4H
      X(1)=0.0
      Y(1)=0.0
      DO 31 I=1,INT
      X(I+1)=X(I)+XINC
      Y(I+1)=0.0
   31 CONTINUE
      DO 34 J=1,N
      DO 35 I=1,INT
      IF(D(J)-0.0)39,34,39
   39 IF(D(J)-X(I))36,36,35
   36 Y(I)=Y(I)+1.0
      GO TO 34
   35 CONTINUE
   34 CONTINUE
      CALL DRAW(INT,X,Y,0,0,LQ,ITITLE,0,0,0,0,0,0,5,5,1,LAST)
C
C GRAPH G18 PLOTS NUMBER OF ACCIDENTS VS. NUMBER OF DAYS IN PORT SINCE
```

APPENDIX II C

```
C BEGINNING OF DEPLOYMENT UNTIL ACCIDENT
C
      XINC=15.0
      INT=10
      ITITLE(7)=8HG18
      LQ=4H
      X(1)=0.0
      Y(1)=0.0
      DO 41 I=1,INT
      X(I+1)=X(I)+XINC
      Y(I+1)=0.0
   41 CONTINUE
      DO 44 J=1,N
      DO 45 I=1,INT
      IF(E(J)-0.0)49,44,49
   49 IF(E(J)-X(I))46,46,45
   46 Y(I)=Y(I)+1.0
      GO TO 44
   45 CONTINUE
   44 CONTINUE
      CALL DRAW(INT,X,Y,0,0,LQ,ITITLE,0,0,0,0,0,0,5,5,1,LAST)
      STOP
      END
      END
```

APPENDIX II C

```
..JOB0161F,POWELL,W.W.
      PROGRAM PLOT
      DIMENSION F(300),G(300),H(300),ITITLE(12),X(900),Y(900)
      N=173
      DO 1000 I=1,N
      READ 1001,F(I),G(I),H(I)
 1001 FORMAT(41X,3F4.0)
      PRINT 1003,F(I),G(I),H(I)
 1003 FORMAT(1X,3F4.0)
 1000 CONTINUE
C
C GRAPH G19 PLOTS NUMBER OF DAYS AFTER ACCIDENT UNTIL DEPLOYMENT IS OVER
C
      DO 1 I=1,12
    1 ITITLE(I)=8H
      ITITLE(1)=8HPOWELL
      ITITLE(2)=8HW.W.
      ITITLE(7)=8HG19
      XINC=30.0
      INT=8
      LQ=4H
      X(1)=0.0
      Y(1)=0.0
      DO 3 I=1,INT
      X(I+1)=X(I)+XINC
      Y(I+1)=0.0
    3 CONTINUE
      DO 4 J=1,N
      DO 5 I=1,INT
      IF(F(J)-0.0)9,4,9
    9 IF(F(J)-X(I))6,6,5
    6 Y(I)=Y(I)+1.0
      GO TO 4
    5 CONTINUE
    4 CONTINUE
      CALL DRAW(INT,X,Y,0,0,LQ,ITITLE,0,0,0,0,0,0,5,5,1,LAST)
C
```

APPENDIX II C

```
C GRAPH G20 PLOTS CUMULATIVE ACCIDENTS SINCE 1 JANUARY 1962
C
      XINC=30.0
      INT=25
      L=N-1
      DO 50 I=1,L
      JJ=N-I
      DO 50 J=1,JJ
      IF(G(J)-G(JJ+1))50,50,55
   55 Z=G(JJ+1)
      G(JJ+1)=G(J)
      G(J)=Z
   50 CONTINUE
      ITITLE(7)=8HG20
      X(1)=0.0
      Y(1)=0.0
      LQ=4H
      DO 11 I=1,INT
      X(I+1)=X(I)+XINC
      Y(I+1)=0.0
   11 CONTINUE
      DO 14 J=1,N
      DO 15 I=1,INT
      IF(G(J)-X(I))16,16,15
   16 Y(I)=Y(I)+1.0
      GO TO 14
   15 CONTINUE
   14 CONTINUE
      DO 17 I=2,INT
   17 Y(I)=Y(I)+Y(I-1)
      CALL DRAW(INT,X,Y,0,0,LQ,ITITLE,0,0,0,0,0,0,5,5,1,LAST)
C
C GRAPH G21 PLOTS NUMBER OF ACCIDENTS VS. NUMBER OF DAYS BETWEEN ACCIDENTS
C
      XINC=2.0
      INT=8
      ITITLE(7)=8HG21
```

UNCLASSIFIED

```
      LQ=4H
      X(1)=0.0
      Y(1)=0.0
      DO 21 I=1,INT
      X(I+1)=X(I)+XINC
      Y(I+1)=0.0
   21 CONTINUE
      DO 24 J=1,N
      DO 25 I=1,INT
      IF(H(J)-X(I))26,26,25
   26 Y(I)=Y(I)+1.0
      GO TO 24
   25 CONTINUE
   24 CONTINUE
      CALL DRAW(INT,X,Y,0,0,LQ,ITITLE,0,0,0,0,0,0,5,5,1,LAST)
      STOP
      END
      END
```

UNCLASSIFIED

[redacted] UNCLASSIFIED

UNCLASSIFIED

[redacted]